POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

Unusual Features Of New J. I. Case Co. Boiler
Corrosion Of Condenser Tubes By Ammonia
Don't Wince At Mathematics
What Gas Turbine Equipment Looks Like
Study Of Coal Sizing

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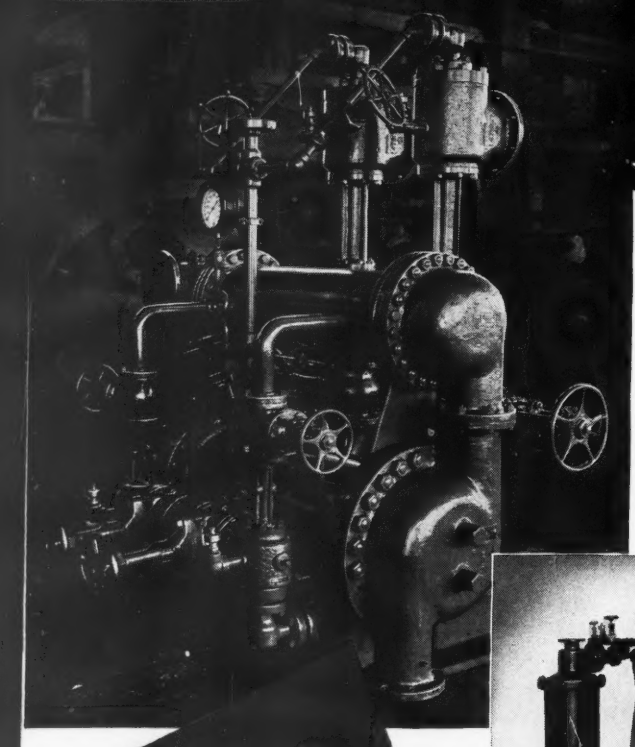
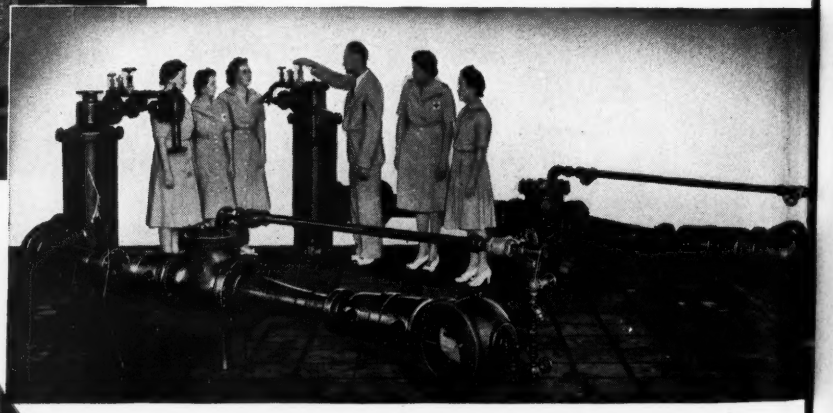
JUNE 1944



Elliott twin two-stage ejector, with surface type inter- and aftercondenser, to serve an Elliott 27,000-sq.-ft. surface condenser in a new high-pressure utility station.

An example of Elliott multi-stage ejectors maintaining extremely high vacuum on processes is the application to the drying or subliming of blood plasma. Many Elliott four-stage ejectors like this are in this service. Elliott five-stage ejectors, obtaining even higher vacuum are being used in the processing of such things as magnesium and penicillin.



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Steam Jet Ejectors

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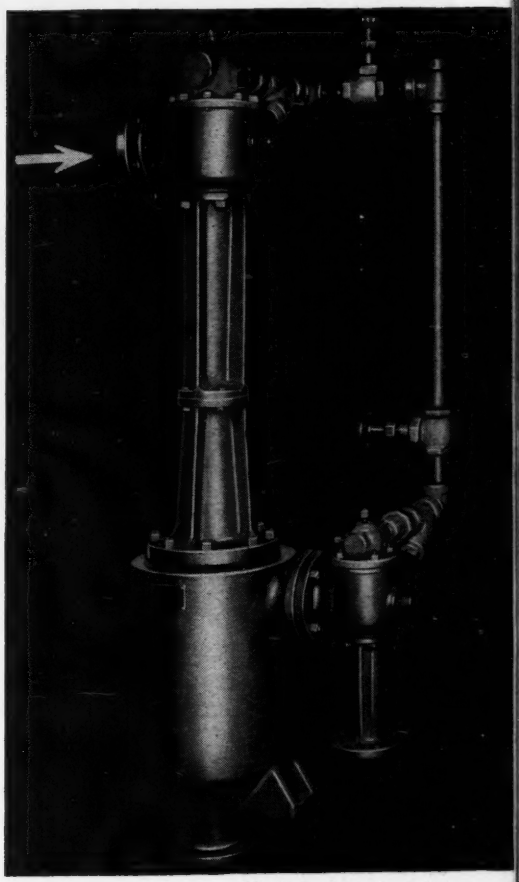
While the toughest applications are in the process industries, Elliott Company can also help power plant engineers in correctly applying ejectors to serve condensers old and new. Some plants are still using reciprocating vacuum pumps, which can always be replaced to advantage by modern correctly-applied steam jet ejectors at a saving in operating and maintenance costs.

Why not profit by the background of experience of Elliott engineers. Check with them on your vacuum problem. Write for Ejector Bulletin G-7.



This type of two-stage ejector with barometric type inter-condenser is used to serve barometric type condensers in many power plants, also is widely used in process industry applications.

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G-388

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Texaco Regal Oils (R & O), a new high in the prevention of rust and oxidation, keep steam turbine systems clean, bearing temperatures normal, governor action smooth and sensitive. These Oils free themselves rapidly from air and water, are highly resistant to gum formation and sludging.

Texaco lubricants have proved so effective in service, that they are definitely preferred in many fields, a few of which are listed at the right.

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FOR ALL TURBINES

TUNE IN FRED ALLEN EVERY SUNDAY NIGHT—CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

POWER PLANT ENGINEERING

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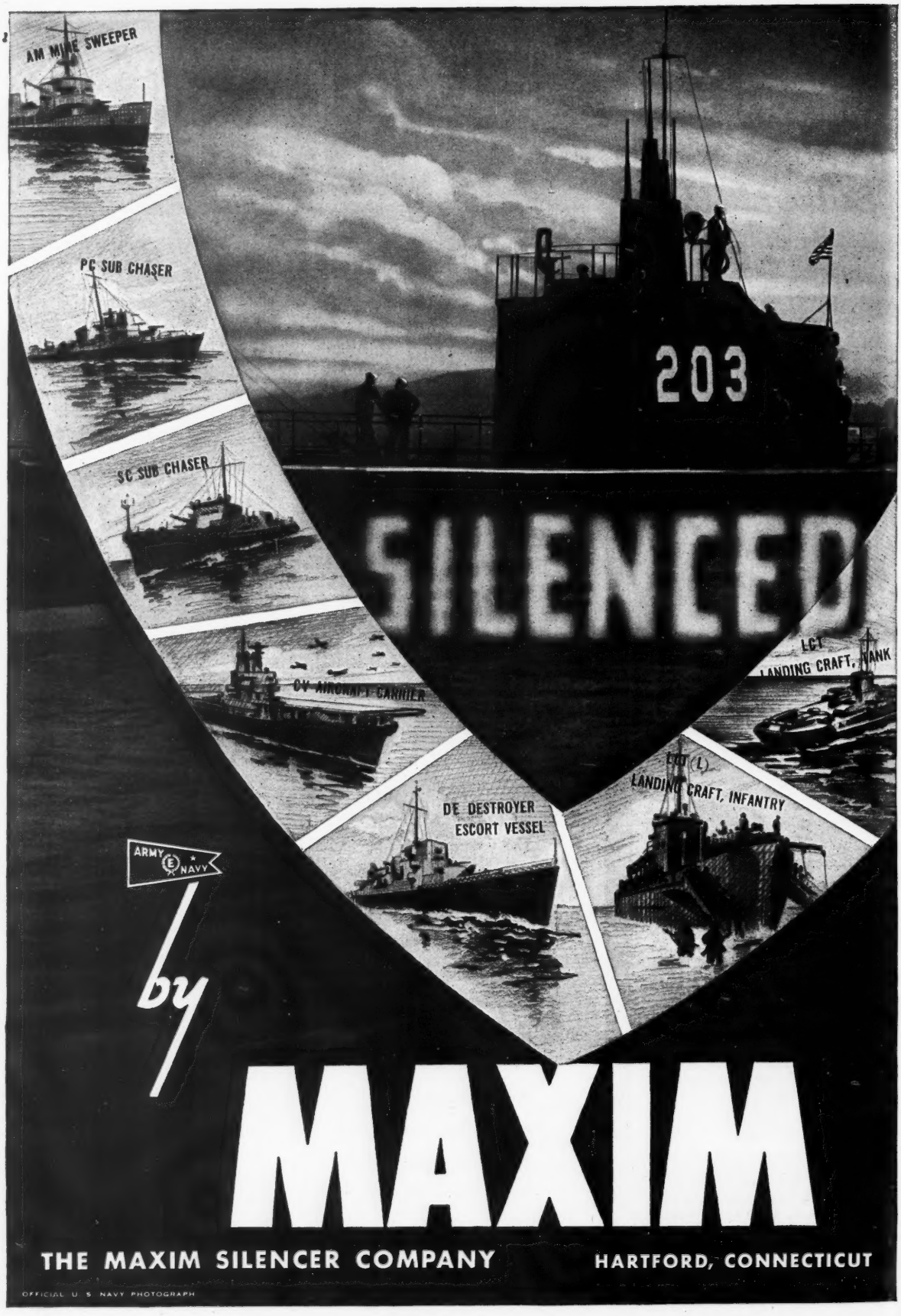
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FRONT LINES

THAT MAN with the wrench again. Judging by the comments on our item on tightening bolts and nuts (Front Lines, February, 1944, page 7, column 1, paragraph 2), a great many engineers are still aware of the importance of the man with the wrench. A number of engineers said that they, too, have always been cautioned to design bolts and nuts to be tightened by a 250-lb fool with a 24-in. wrench and a 4-ft length of pipe on the end of that. You may remember that we called attention to the very fine paper by J. O. Almen of General Motors Corp. discussing the strength of bolts and the proper method of tightening nuts and its effect on bolt fatigue. It is particularly interesting, therefore, to see that Mr. Almen's paper is being published in full in a new publication called Fasteners, issued by the American Institute of Bolt, Nut, and Rivet Manufacturers. Volume I, Number 1 of this publication, which we have just received, contains the first half of the paper, well illustrated with diagrams; the second half will be published in a subsequent issue. Even though you know how to tighten bolts and nuts properly in practice, you may still be interested in the theory and reasoning underlying the practice. One of Mr. Almen's diagrams shows the tremendous importance of the man with the wrench, as compared to designer, metallurgist and processor, in their relative responsibility for fatigue durability of bolts.

JUST ON THE CHANCE that somebody who is operating high temperature equipment has not been put in touch with the work of the Joint Committee of the EEI-AEIC on Graphitization of Piping, we hereby report that its Progress Report No. 2 has been issued as of March 1, 1944. This committee, headed by Alex D. Bailey as chairman, Sabin Crocker, secretary, has summarized its second report rather fully in the April, 1944, issue of the Edison Electric Institute Bulletin published by the Edison Electric Institute, 420 Lexington Avenue, New York City. There are only a relatively few installations of power or process equipment in the country operating at temperatures of 900 F or over and it is assumed by this time all those using the equipment have become fully familiar with the work done on graphitization of piping.

IT WAS EXTREMELY significant that J. A. Krug, in his address before the Midwest Power Conference, just before leaving his post as Director of the Office of War Utilities to become a lieutenant-commander in the U. S. Navy, advocated, as one of the five specific post war programs that the power utility industry should investigate, a program to advance the application of reversed cycle refrigeration in the home heating field. This is the cycle, as readers know, in which an assembly of heat transfer equipment and a heat pump is used to produce either a heating or a cooling effect in a given enclosed place. But in connection with some of the things now shaping up in methods of burning fuel, converting its energy into electricity and delivering that electricity to the point of use, the full implications of a really effective development of reversed or, more properly, reversible cycle refrigeration, are, if we may coin a phrase, staggering to the imagination. Just try it for a few moments and see if yours doesn't stagger.

WHAT IS GOING to become of the women now in war production when that production stops? In many of the armament factories the only men to be seen are the old timers who were in the automobile or machine tool or related businesses long before the war and the operating staffs of these plants, also of certain of the ordnance plants, are largely women. It must not be forgotten, however, that many of these women came into these plants from civilian activities like the making of children's underclothing, school teaching, office work and a host of other activities that have either been curtailed completely during the war or that do not offer either the high wages nor the patriotic rewards of war work. Many of them also do not seek careers in industry but want to go back to homemaking when the war is over. Many of them, therefore, will do this; many others will go back to the former civilian activities that will be resumed after the war. It is well to remember these factors when looking at statistics of expected unemployment due to the stopping of war production. A former housewife now running a lathe in a war plant will be unemployed, according to the statisticians, the minute that lathe stops. Well, you know what statistics are the third form of.

YOU DON'T often think of house painters as being highly proficient psychologists. You probably think of one house painter named A. Hitler who *thought* he was a very proficient psychologist but whose psychology seems to be backfiring right in der Fuehrer's face. However, it now turns out that this A. Hitler never was a house painter at all. He tried to be an architect and artist, he says (he really was a Black Reichswehr spy), but never a house painter. So you can't blame his bad psychology on that. However, there is a painter in our town, according to the report of one of our spies, who rates at least a PhD and possibly an ScD for his knowledge of the workings of the human mind and of the human emotions. Away out on the South Side, our spy reports, this painter has done a very fine job on the front of a store. Having finished it, he found a suitable spot on the freshly-painted wall near the front door of the store, painted on it, in a glossy black line, a circle about 15 in. in diameter and above the circle hung a placard bearings these words: "FRESH PAINT—TEST HERE."

FLAME SPRAYING of bronze on steel, which has been used to produce bronze faced pistons, has at last been described by the Neo Mold Co. of Cleveland which developed the process to make special pistons for Cleveland Pneumatic Aerol, Inc., division of the Cleveland Pneumatic Tool Co. In this process, comparatively light steel blanks are sprayed with a special bronze alloy to a certain thickness on the bearing surface. This is rough machined in the initial production, then given the required high finish with oil grooves. One important factor in the resulting product is its oil bearing quality. A sprayed bronze absorbs and retains oil and becomes self-oiling after short use, it is claimed. The process is now being applied to all types of pistons for compressors and pumps.

AS SUMMER APPROACHES, says the General Radio Experimenter, we prepare for the usual crop of complaints that come in, regarding the erratic behavior of electrical measuring equipment, particularly precision impedance bridges. The various stories conflict. Sometimes the bridge seems to read high, sometimes low; balance may drift badly or suddenly jump to a new value; it may show increasing errors as the frequency is lowered, or the balance may shift with applied voltage. The article (in the April issue) goes on to explain that there is just one cause for such behavior and that is high relative humidity. It then discusses the principal reasons for this and some of the things that can be done to overcome the difficulty.

IN CONNECTION with Question No. 255 in the Q.&A. Section of Practical Engineer and Electrician, April issue, the recent report of WPB's Safety and Technical Equipment Division on the distribution of safety equipment in major consuming industries in 1943 may be of interest. Eleven types of safety equipment were surveyed. Items in descending order of unit numbers used in 1943 were: safety shoes; safety goggles; respirators; hard hats; face and eye shields; welding shields and helmets; safety cans; ladder safety shoes; salt tablet dispensers; safety belts and harnesses; and gas masks. Military and other Government use and export are not included. Prior to the war, the report says, extraordinary emphasis was placed on the so-called personal factor in accident prevention programs; relatively little attention was given to safety equipment. Safety engineers, supervisors, foremen, management, labor and others concerned with the industrial safety problem now agree that to the three E's of safety—Engineering, Education and Enforcement—should be added the all-important E, Equipment.

AN INTERESTING TALE comes from the April issue of the Aluminum News Letter about an aluminum handle found on a German Messerschmitt shot down over northern Tunisia during the African campaign. Records of the Aluminum Co. of America reveal that the part is an aluminum sand casting originally made with thousands of others, for the Glenn L. Martin Co. of Baltimore, Md., and shipped to Martin in 1943. A number of these items had also been shipped to the Martin Co. in Nebraska in 1942. The fact that the part was found on one of the latest model Messerschmitts leads to a number of interesting speculations: 1. Marshal Goering likes our aluminum better than his own; 2. Hitler is running low on aluminum; 3. While at the moment the krautheads are taking it, they apparently can't make it! Take your choice.

THE POWER OF THE HORSE is so much a part of the engineer's thinking that we fear he seldom visualizes the animal itself. But now, with millions of them in use in this country and abroad, the problem has arisen of applying that power of the horse to useful work. How are you going to harness a horse when you haven't got anything to make harness out of? In other words, you've got a leather shortage. Well, the National Bureau of Standards has collaborated with the War Production Board and the manufacturers in developing a horse harness made of woven cotton webbing. After a thorough series of actual service tests at the University of Maryland, a specification for it was issued by WPB. The Office of Lend Lease has already ordered 60,000 sets of harness under this new-specification for use in North Africa and larger purchases by other agencies are under consideration.

GLYCERINE is finding increasing uses in processes for electrolytic polishing of metals and in plating methods. A recent addition to this growing list is a procedure for chromium plating metals such as steel parts for linotype machines described in U. S. Patent 2,327,676 granted to J. W. Spence. According to the specifications, the material to be plated is placed in a boiling cleaning solution, in which it is alternately made cathode and anode. After removal from this solution, the material is rinsed and then treated as an anode in a bath containing 66 per cent sulfuric acid, 5 per cent glycerine, and water. It is then electrolytically plated with chromium in a chromic acid plating bath while heated, and then placed in a mass of slowly cooling molten material such as lead. Intermediate coatings of cobalt, copper or nickel may be used.

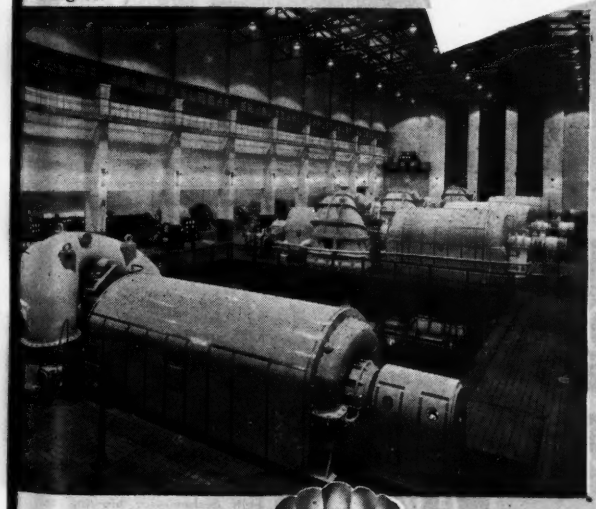
SEVERE Navy tests of Diesel engine filters have revealed that the new detergent, or additive-type, lubricants largely have solved the problem of keeping engines clean; filtration now serves chiefly to remove abrasives, the Chicago SAE meeting was told by Lieutenant H. V. Nutt, USNR, of U. S. Naval Engineering Experiment Station, Annapolis, Md. He said lubricants have been so greatly improved as to take over the filters' reputed functions of reducing valve and ring sticking, blow-by, and bearing corrosion. The Navy now uses four standard filter sizes, two large and two small, instead of the more than 40 varieties once installed, Lieutenant Nutt reported. Abrasives are maintained at lowest concentration, he said, by circulating oil through filter elements at the highest practical rate possible with "shunt" operation, high oil temperatures, and a high pressure drop across the filter element.

THANKS TO THE LEGIMETER developed by Douglas J. Wishart, one of the oldest enemies of engineers, architects and designers—the blueprint that is rejected because of insufficient contrast in the original drawing—is tottering on its last legs at The Glenn L. Martin Co. in Baltimore. The Legimeter is a device for pre-determining whether or not a drawing will reproduce satisfactorily while it is still in the hands of the draftsman, or in the case of older drawings, before they are sent to the blueprint machines. It consists of a two panel illuminated table. In the first panel are samples of drawings from which satisfactory prints have been made by the Army and Navy, selected as standards of minimum satisfactory contrast. The second panel is a clear sheet of ground glass on which the draftsman can place the drawing to be evaluated. Since both panels are illuminated by light of the same intensity, it is possible for the draftsman to determine at a glance whether or not his drawing is heavy enough for satisfactory reproduction, and if it is not, to heavy it up on the spot. The accuracy of the evaluation is assured by the fact that the comparison is made by transmitted rather than reflected light—the same medium that is used in the actual making of the blueprint. In addition to the comparison table, the Legimeter includes additional devices for the instruction and training of inexperienced draftsmen in a three panel backboard. The two outside panels, illuminated like the table by transmitted light, contain examples on the left side of satisfactory drawings, and on the right, of unsatisfactory drawings. In the recessed center panel, illuminated by reflected light, are the blueprints made from these drawings, prints which have actually been accepted or rejected by the Army. Demonstrating what happens when a drawing lacks sufficient contrast, this backboard provides an ideal means of showing the young draftsman the difference between a drawing that looks all right, and one which will reproduce satisfactorily.

When the DIVERGING NOZZLE was a "new development" a 1-Job turbine oil was good enough

Although the expanding nozzle was patented in 1867, for steam injectors, Gustaf De Laval is given credit for being the first to apply the principle of a diverging nozzle for the expansion of steam to a turbine. It was in 1888 that he first experimented with the diverging expansion nozzle. But the high velocity of the steam in this type nozzle made it very difficult to balance a wheel with sufficient accuracy. De Laval then combined the flexible shaft with the diverging nozzle, as shown in the sketch above.

modern turbines may embody many of operational principles of those first turs of the late 1800's, but the speeds and temperatures at which modern turbines rate demand an oil that does more than ricate. They need Shell Turbo Oil . . . the b oil that prevents rust, and at the same e has the ability to resist oxidation to an ual degree.



. . . But modern turbines need this 2-JOB OIL!

1. That prevents rust

2. That has superior oxidation stability

IF YOUR TURBINES are of modern design, and you're using simply a "good turbine oil". . . look out! That's not enough. To keep the modern steam turbine operating dependably, efficiently and economically, your oil must have the ability to do 2 jobs—(1) *prevent rust*, (2) *resist oxidation* to an unusual degree. Shell Turbo Oil does *both* of these jobs at once . . . does them so well, in fact, that it has been turning in outstanding performance records.

Shell Turbine Oil was the first of its type to be approved as meeting rigid U. S. Navy specifications. And it is Shell Turbo Oil that is still going strong after 20,000 hours operation in the turbo blowers of a leading steel company, where previous turbine oils used did not last more than 4000 hours. There are other equally impressive records of Shell Turbo Oil we'd like to show you. Write: Shell Oil Company, Inc., 50 West 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, Calif.

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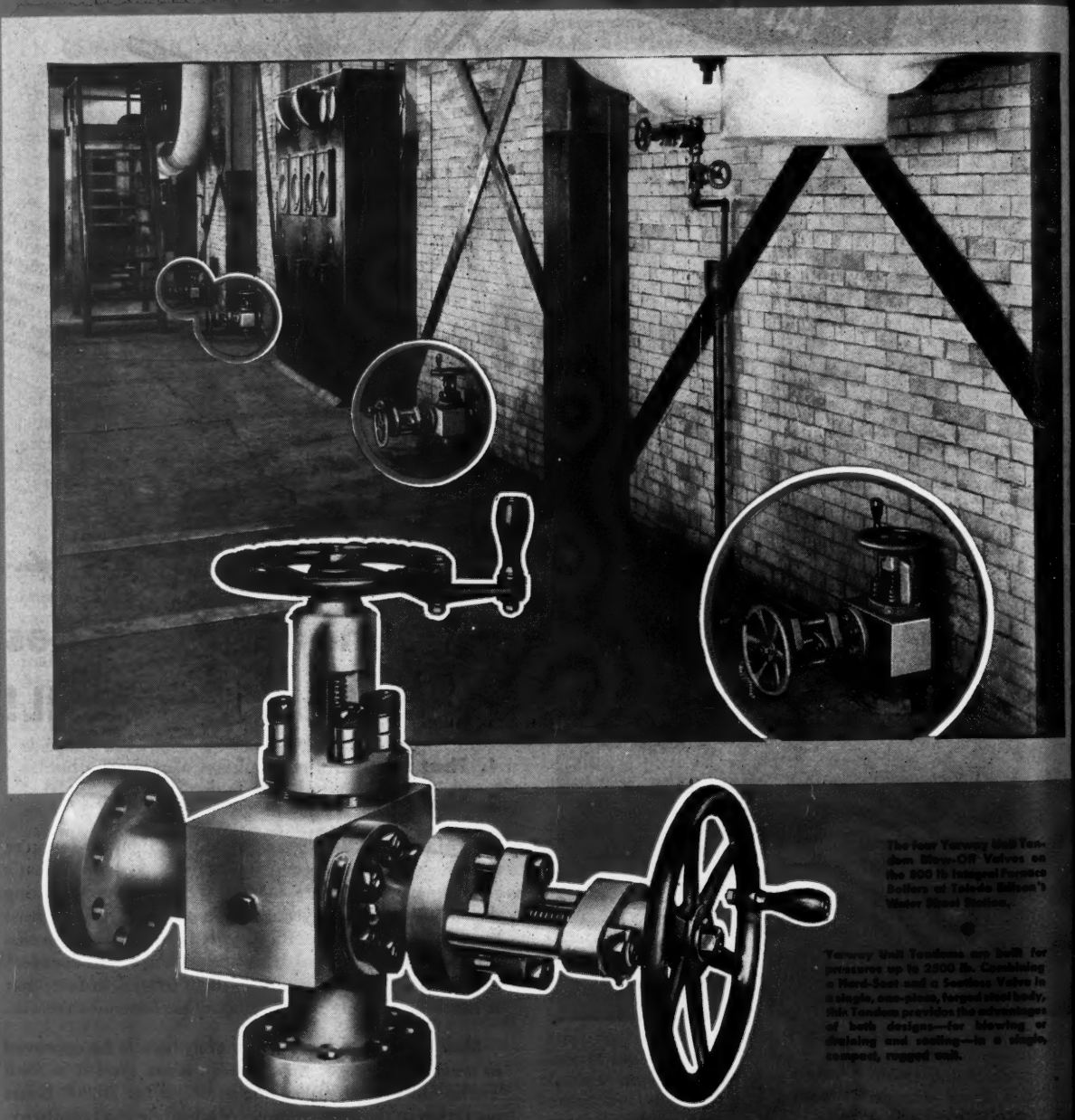


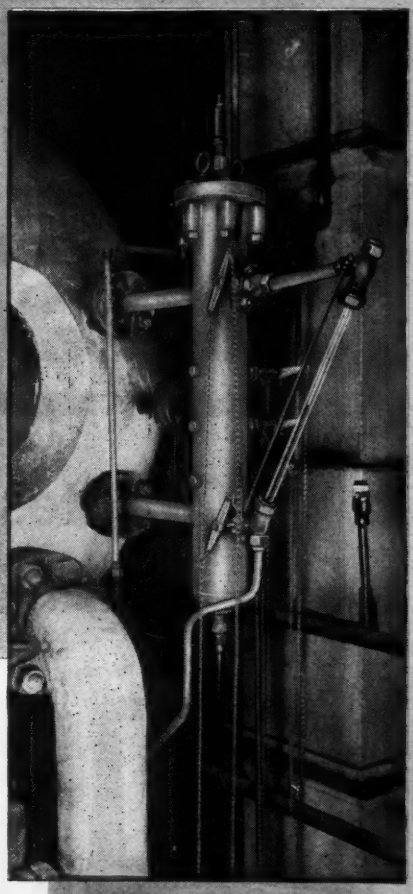
The Four Yarway Unit Tandem Blow-Off Valves on the 800 lb Integral Furnace Boilers at Toledo Edison's Water Street Station.

Yarway Unit Tandems are built for pressures up to 2500 lbs. Combining a Hard-Seat and a Seatless Valve in a single, one-piece, forged steel body, this Tandem provides the advantages of both designs—for blowing or draining and sealing—in a single, compact, rugged unit.

YARWAY

Company All the Way

- **YARWAY UNIT TANDEM** *Blow-Off Valves*
- **YARWAY HI-LO ALARM** *Water Columns*
- **YARWAY SESURE** *Inclined Water Gages*



One of the Yarway HI-LO Alarm Water Columns and SESURE Inclined Water Gages in use at the Water Street Station of the Toledo Edison Co. This station, temporarily operating on 300 lb pressure, selected Yarway water level indicating equipment for that pressure range—will replace with higher pressure equipment when plant is stepped up to design pressure of 900 psi.

Many years of favorable experience with Yarway Blow-Off Valves led Toledo Edison to select them for their first high pressure unit—Acme Station—back in 1937. Six sets of Seatless and Hard-Seat Tandems were used, followed again in 1940 by 12 sets of Yarway Unit Tandems, making this station 100% Yarway Blow-Off Valve equipped.

More recently, when the 800 lb Integral Furnace Boilers were purchased for the Water Street Station (illustrated), four more Yarway Unit Tandems were installed.

The reason why high pressure utility and industrial power plants, one after another, select Yarway Blow-Off Valves is to be found in such records of performance as —"still tight after 3000 blows at more than 1300 psi, without the replacement of a single part or repairs of any nature."

Yarway Valves "stand up and take" the most severe demands made upon them because they are the result of over a quarter century of mechanical and metallurgical research and field experience.

Get this insurance against blow-off valve trouble and expense and resultant costly power shut-downs.

Write for Catalog, Section B-431 for pressures from 400 lb to 2500 lb. Section B-424 for lower pressures.

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meets the most severe operating co

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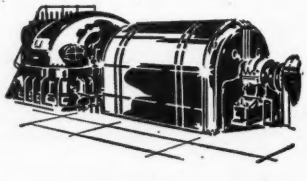

Now comes a major development that can't be treated as just an improvement, a long step forward that meets today's most severe turbine operating conditions. Never satisfied, Socony-Vacuum has created a great new Gargoyle D. T. E. Oil for turbines.

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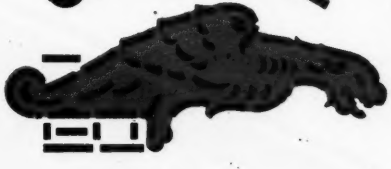

Lubricants

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✓ ***Extra Resistance to Oxidation:*** Oxidation protection—PLUS—is needed to meet the effect of greatly increased temperatures in modern turbine operation. Your turbine oil should have this PLUS protection.

✓ ***Maximum Anti-Rust Qualities:*** The possibility of the presence of water demands that the oil should furnish maximum protection against corrosion. Your turbine oil should give this protection.

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An Announcement of Major Significance to every user of Automatic Control Instruments

HENCEFORTH, McAlear and Hanlon-Waters will function as divisions of *one* company. This brings together the leading supplier of automatic control instruments for the oil field and the foremost producer of similar devices for heating and industrial service.

Hanlon-Waters products will continue to be available to the oil field from the Tulsa plant, under the same management and engineering supervision as heretofore.

McAlear, whose products have for a third of a century dominated the process, industrial and heating fields, will continue to operate out of Chicago.

Customers of each company will benefit from this pooling of patents, designs and—*engineering experience.* The Hanlon-Waters oil field line of automatic controls, separators and tanks, will be immediately supplemented by such McAlear controls as the combined engineering staffs of the two companies regard to be best for such service. Similarly, the McAlear line will be complemented by outstanding features and products of Hanlon-Waters manufacture.

This affiliation provides unmatched manufacturing, engineering and research facilities. The new leadership thus established will find quick expression in new control developments (some already well under way) which will pace future industrial progress.

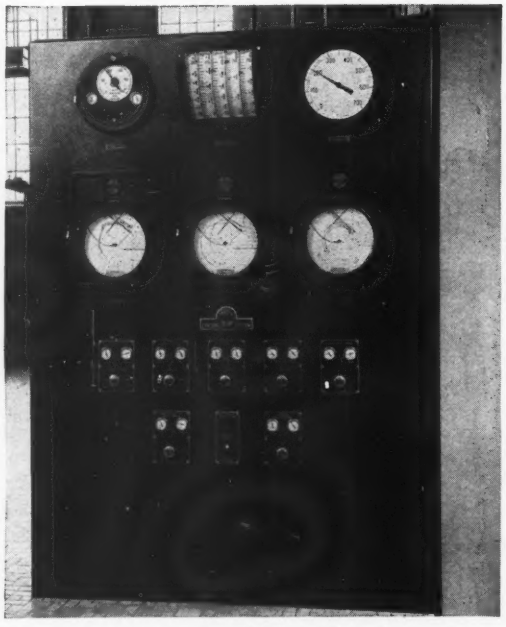
McALEAR MANUFACTURING COMPANY • CHICAGO
Control Instruments for Industrial, Power and Heating Service

HANLON-WATERS COMPANY • TULSA, OKLAHOMA
Control Instruments, Tanks, Separators, Portable Pipe Lines, for the Petroleum Field

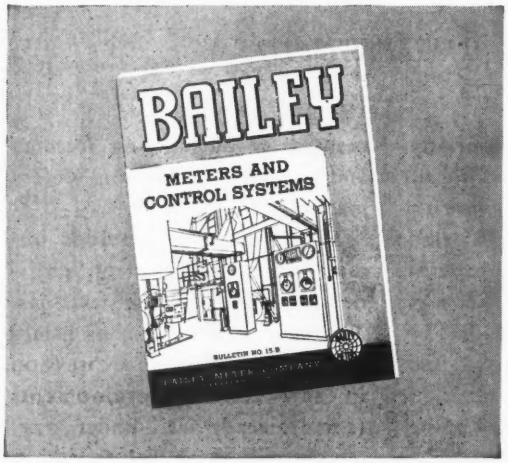
AFFILIATED COMPANY

CLIMAX ENGINEERING COMPANY • CLINTON, IOWA
Gas, Butane and Diesel Engines, Generating Sets

A Service FOR BETTER POWER PLANT PERFORMANCE



Bailey Control Panel for a 60,000 lb. per hour Gas-fired boiler in a Mid-west power plant.



This Bulletin, No. 15-B tells how and where Bailey Meters and Control Systems serve the steam plant. Write for your copy.

Instead of offering simply meters and controllers, Bailey Meter Company makes available a service which helps power engineers to improve plant performance from the standpoint of:

1. Continuity of Operation
2. Steaming Capacity
3. Fuel Economy
4. Conservation of Man Power
5. Safety

This engineering service starts with a careful consideration of the improvements which may be effected in the generation and utilization of steam and in the control of industrial processes. It continues with the application, design, construction, calibration, installation and adjustment of equipment necessary to secure the desired improvements.

Combustion control, for instance may be supplied as a remote manual system, a partial automatic system, or as a complete automatic system. In any event, the equipment furnished is tailored to the characteristics of the steam generating unit.

Although the basic component parts of Bailey Meters and Control Systems are standardized and produced in quantity to keep the selling price as low as possible, each meter or system is engineered, adjusted and calibrated to satisfy conditions as they exist in the plant where it is to serve.

When field tests must be run to completely adjust equipment to operating conditions, they are conducted by experienced Bailey Field Engineers who are permanently located in the principal industrial centers of the United States and Canada. Final adjustment of the Bailey Boiler Meter is done in this manner. A combustion test is conducted on the boiler to determine the lowest percentage of excess air under which it can be economically operated. With the aid of the boiler meter, which has been installed but not yet finally adjusted, and an orsat flue gas analyzer, the Bailey Engineer determines this lowest economical value. It is determined with respect to 1—CO losses, 2—unburned fuel losses, 3—smoke, 4—refractory deterioration due to excessive furnace temperature.

This value of excess air for which the Bailey Boiler Meter is adjusted may not represent the highest combustion efficiency possible, but it does represent the highest combustion efficiency consistent with economy, reliability and maximum capacity, which is after all the final result desired in boiler plant operation.

For an outline of the many ways in which Bailey Meters and Control Systems serve the modern steam plant, ask for a copy of Bulletin No. 15-B. G-15-1

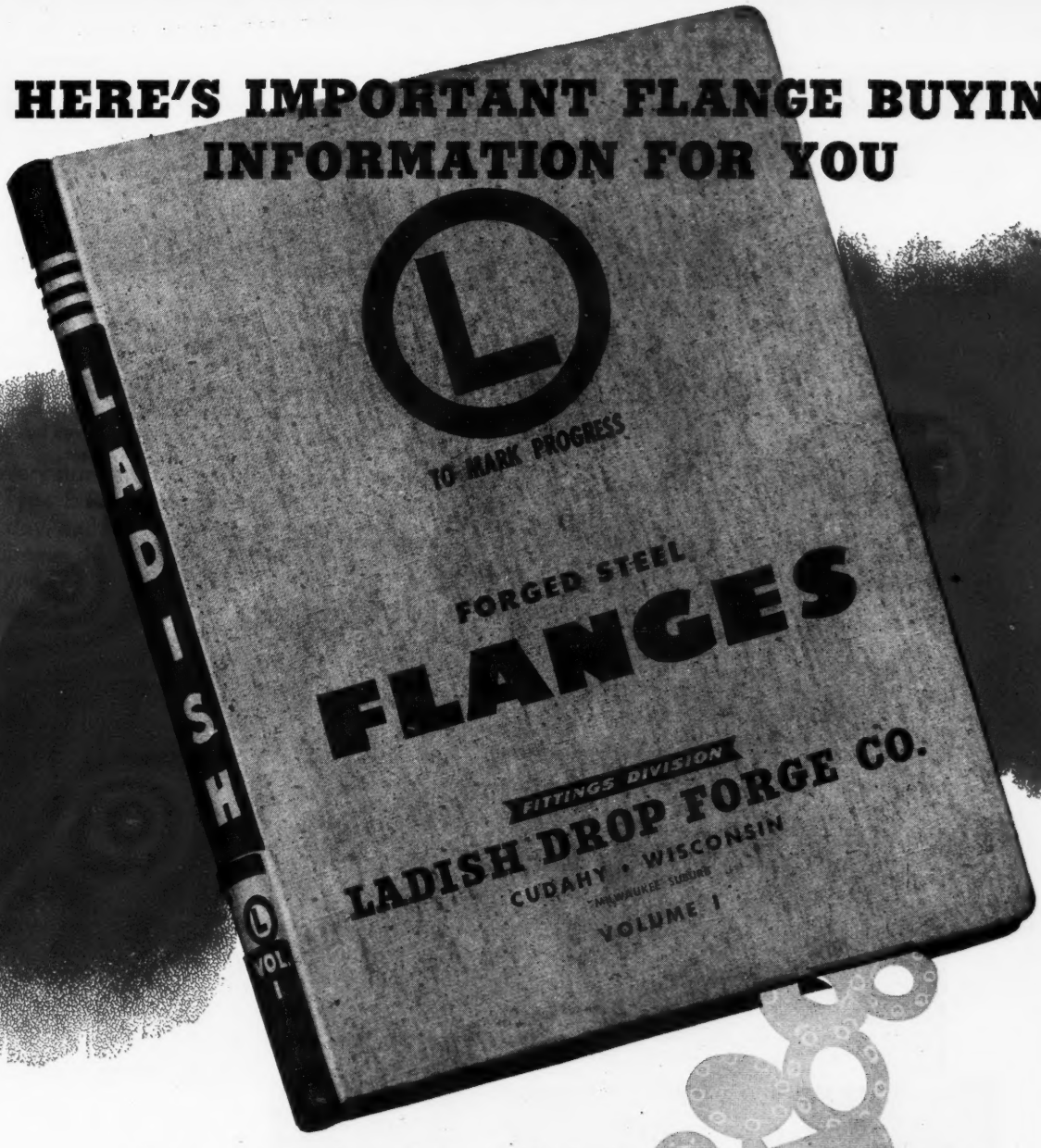
BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

BAILEY METER CONTROL

The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

HERE'S IMPORTANT FLANGE BUYING INFORMATION FOR YOU



The New Catalog of the Ladish Fittings Division Describes the *Complete* Line of Ladish Forged Steel Flanges

Your copy of this catalog contains complete descriptions, prices and specifications of the full line of Ladish *Controlled Quality* Forged Steel Flanges . . . the distinctive green colored flanges that are being used in piping systems now.

Purchasing Agents, Engineers and Specification Writers will find this Ladish Catalog a most valuable reference. Write for your copy today.

TO MARK PROGRESS

ARMY E NAVY

FITTINGS DIVISION

LADISH . DROP FORGE CO.

CUDAHY • WISCONSIN

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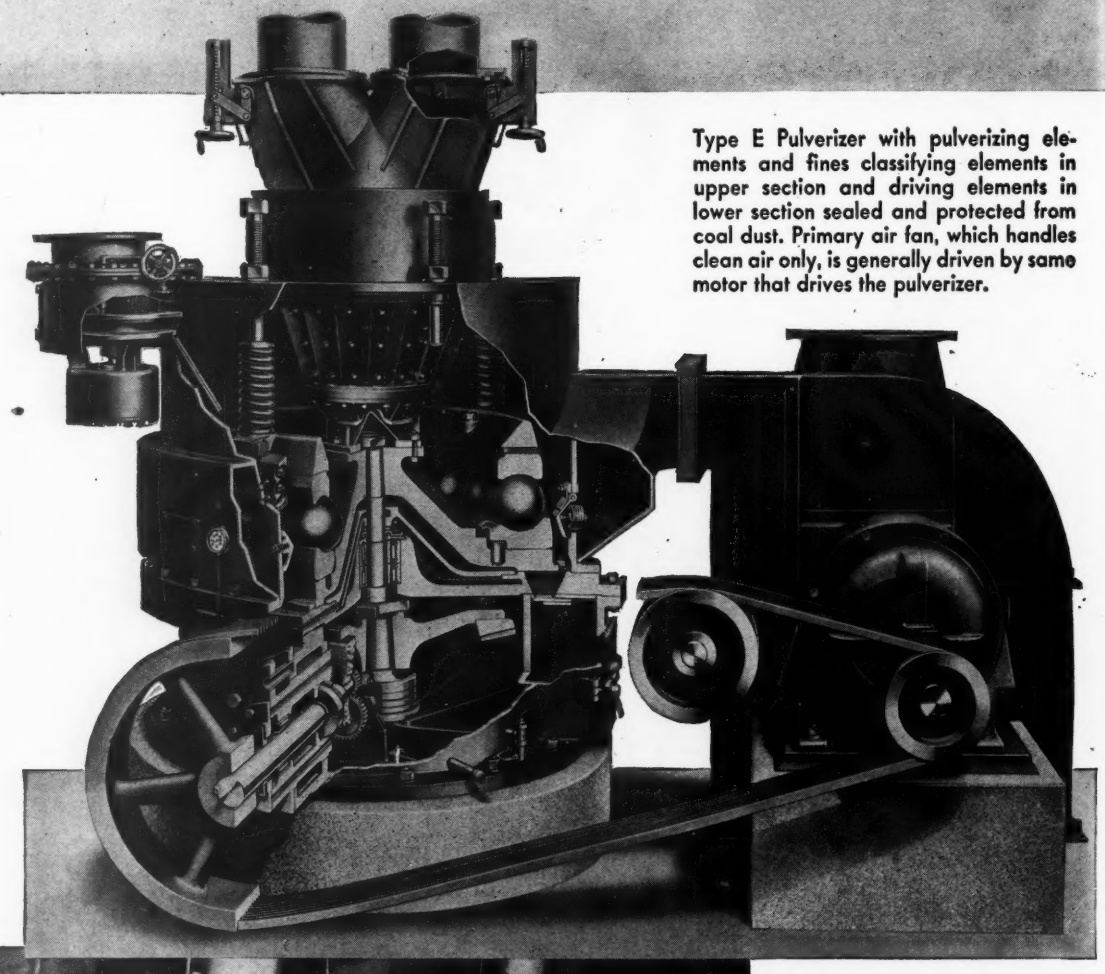
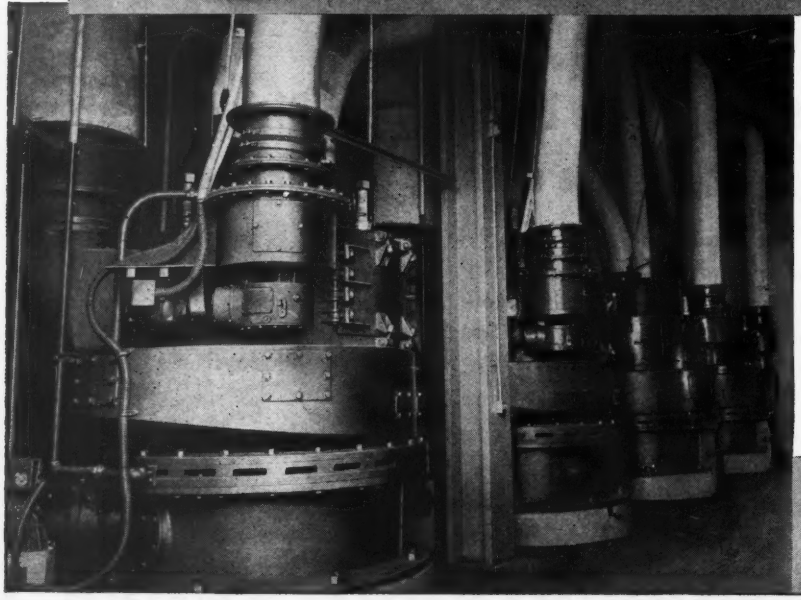


Type E Pulverizer with pulverizing elements and fines classifying elements in upper section and driving elements in lower section sealed and protected from coal dust. Primary air fan, which handles clean air only, is generally driven by same motor that drives the pulverizer.



Over 400 Type E Pulverizers are in service or on order for direct firing boilers. Individual installations have as many as 16 units.

Type E Pulverizer

Fits into Any Day's Fuel Picture

Operates reliably and effectively in direct-firing pulverized-coal systems

By every standard of direct-firing pulverizer performance, the Type E Pulverizer fits into the fuel economy picture any day, and especially so during the present emergency requirements.

Type E Pulverizers—

Are reliable in service and low in maintenance, as measured in service hours before replacement of parts becomes necessary.

Respond readily to load changes—output controlled at one point, the primary air damper, and are adoptable to fully automatic control.

Maintain fineness and capacity throughout life of grinding elements.

Handle coal of a wide variety and, due to drying in the mill, can handle coal with as much surface moisture as it will carry.

These and other features of the Type E Pulverizer are given in more detail in Bulletin G-30-A. Copies obtainable on request.

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET, NEW YORK, N. Y.

The Army-Navy "E" and Maritime Commission Award flags are floated proudly at the plant that builds Type E Pulverizers.

Ball-bearing grinding element of the Type E Pulverizer. Simple—Sturdy—Efficient.

For a copy of this bulletin return this pasted on a penny post card with your name and address.

BABCOCK & WILCOX G-244T

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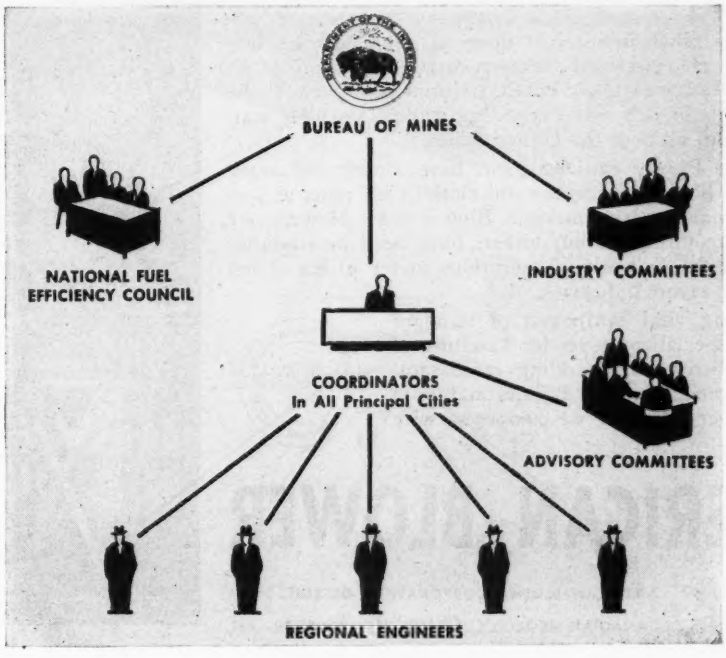
TO HELP YOU SAVE FUEL!

HOW THE NATIONAL FUEL EFFICIENCY PROGRAM FUNCTIONS



The calibre of these men – the Coordinators of the National Fuel Efficiency Council – speaks for the character of the program they have undertaken which is a drive by industry and for industry to help stretch the entirely inadequate fuel supply of America by promoting greater fuel efficiency and reducing heat losses.

Each of these coordinators will direct a group of regional engineers in his own locality – one of whom will visit your plant to enlist your cooperation. He will carry with him helpful information on fuel conservation which has been compiled by voluntary committees comprising the manufacturers of all classes of equipment used in the production and utilization of steam. All of these men are donating their services to help your country avert a disastrous fuel shortage.

If they succeed in attaining the first year's objective – the conservation of 29,000,000 tons of coal and proportionate amounts of gas and oil – they will help the country through the threatening winter of 1944-45 when fuel promises to be the most critical of all critical materials. If they succeed, they will avoid curtailment of war production and save industry from the threat of shortages that otherwise might require relief in some form of allocation.

And they will succeed if every man in industry who uses fuel recognizes the stark necessity of the situation in terms of the war effort abroad and civilian life at home – and lends his fullest cooperation. A-794

To obtain more details write the coordinator nearest you.

This space is contributed by the undersigned company for the purpose of furthering the important work of the National Fuel Efficiency Program.

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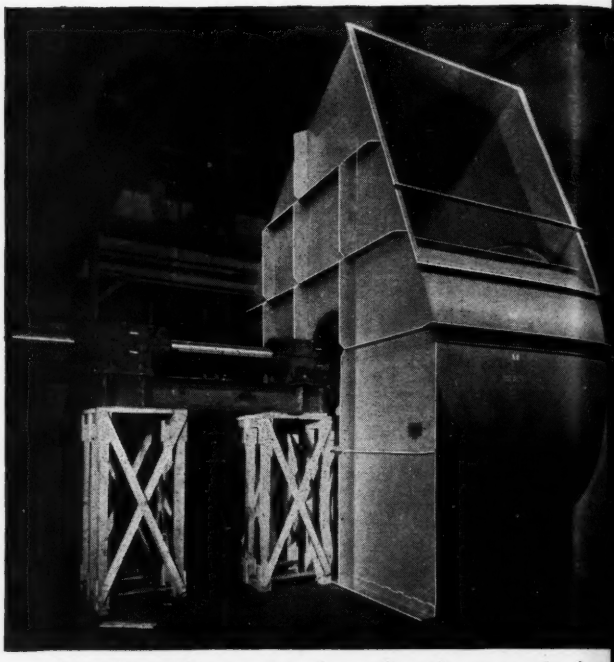
Progress and Power in the TEXTILE

Perhaps no other industry is quite as dependent on low cost, dependable electrical energy as textile and rayon manufacturers. America's great Public Utilities have met all the requirements of this ever expanding group in widely scattered sections all over the United States.

American Blower engineers, too, have contributed much to the task of making rayons and cloth of all types at low cost. For many years American Blower fans, blowers, air conditioning units and humidifiers have been maintaining healthful, efficient working conditions in the plants of the textile and rayon industries.

Furnishing vital equipment of standard as well as specialized types for handling of air in industry, and building mechanical draft equipment, dust collectors and fluid drives, is our job. May we co-operate with you?

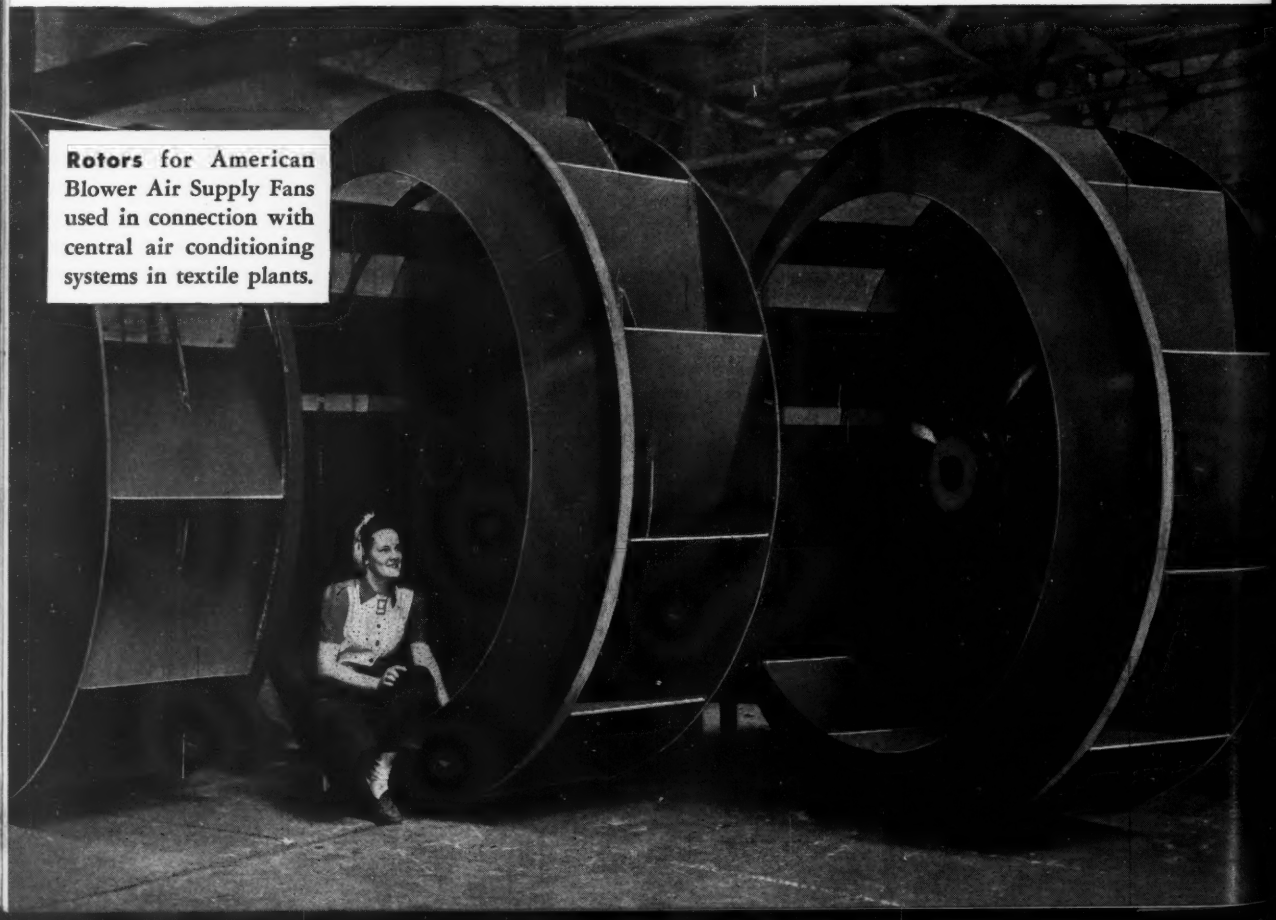


American Blower Fan for exhausting organic fume from spring room machines in a rayon plant.

AMERICAN BLOWER

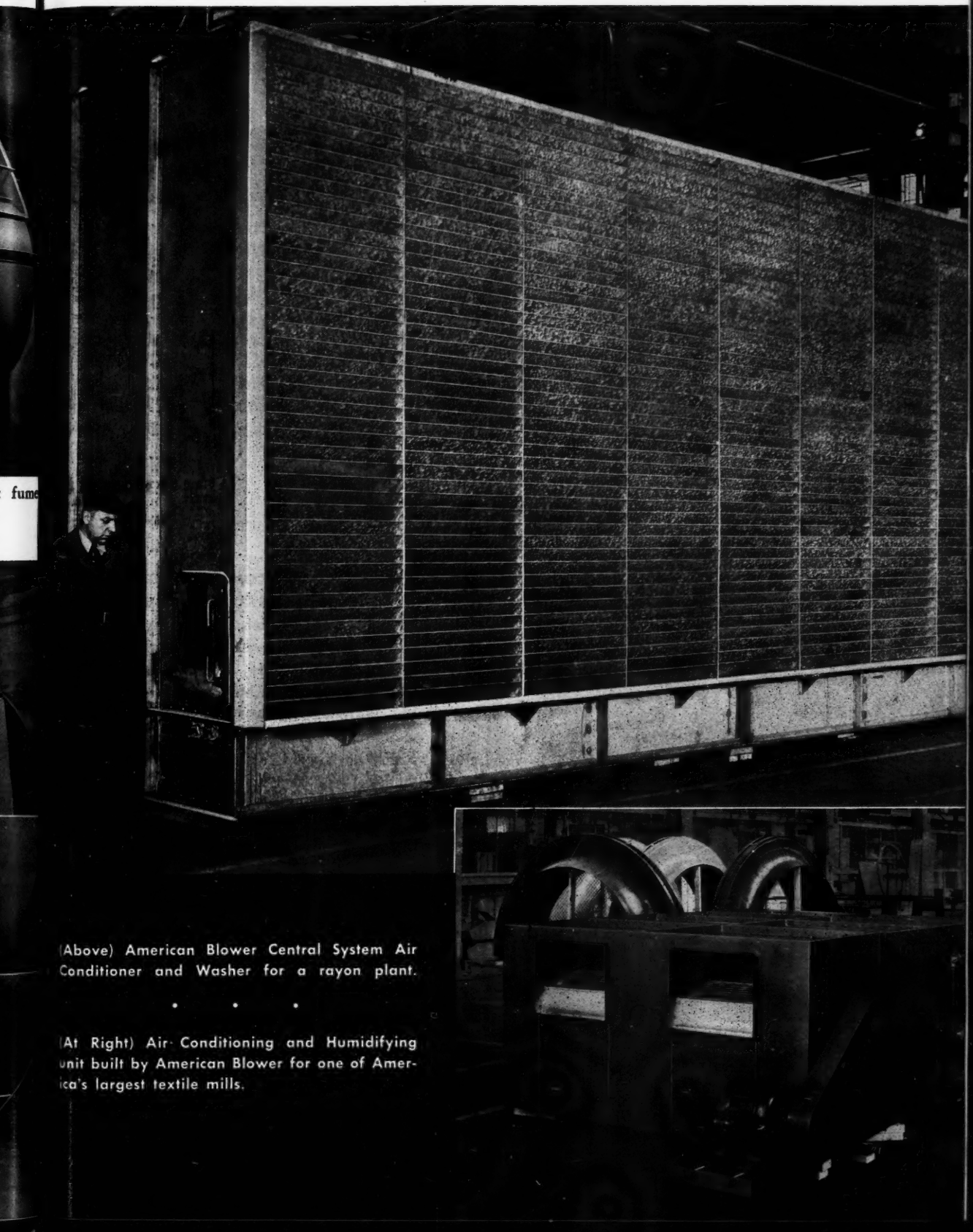
ARMY E NAVY
For Production "Well Done"

AMERICAN BLOWER CORPORATION, DETROIT, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.
Division of American Radiator & Standard Sanitary Corporation



Rotors for American Blower Air Supply Fans used in connection with central air conditioning systems in textile plants.

AND RAYON INDUSTRIES

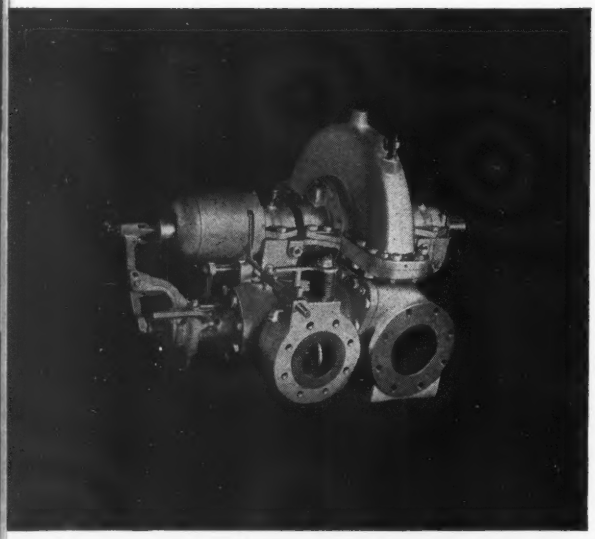


(Above) American Blower Central System Air Conditioner and Washer for a rayon plant.

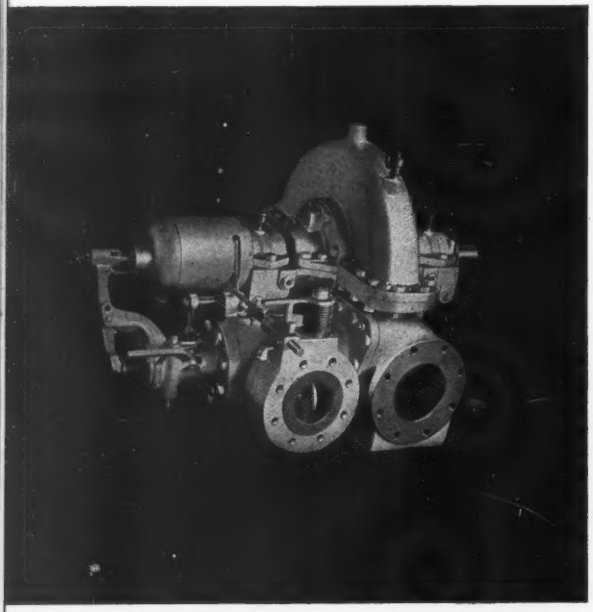
• • •

(At Right) Air-Conditioning and Humidifying unit built by American Blower for one of America's largest textile mills.

TO SOLVE YOUR MECHANICAL DRIVE PROBLEMS

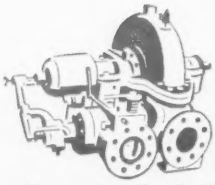


Type C-14 Single-stage General-purpose Turbine. Built for service at 5 to approximately 200 hp; speed range 1000-5000 rpm. Suitable for use with steam pressures through 600 lbs. gauge, and for total temperatures through 750° F.



Type C-20 Single-stage General-purpose Turbine. Built for service up to approximately 600 hp; speed range 1000-5000 rpm. Suitable for use with steam pressures through 600 lbs. gauge, and for total temperatures through 750° F.

TURBINE HELP QUICK. When you need steam for mechanical drives, phone Westinghouse Steam Headquarters. Because Westinghouse maintains offices in every major city, a trained industrial engineer can be in your plant quick—ready to discuss your steam problems and recommend the turbine your job requires. You'll find a "Westinghouse office near you" handy—especially on rush war jobs.



COMPLETE LINE. A call to Steam Headquarters eliminates the bother of "shopping" for the size turbine your steam conditions require. Westinghouse builds a complete line of mechanical drive turbines—from 5 to 3000 hp—PLUS a complete line of auxiliary equipment. So with one purchase order, you centralize responsibility for design, manufacture, delivery and servicing of all your mechanical drive turbines and auxiliaries.

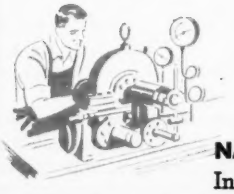
Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

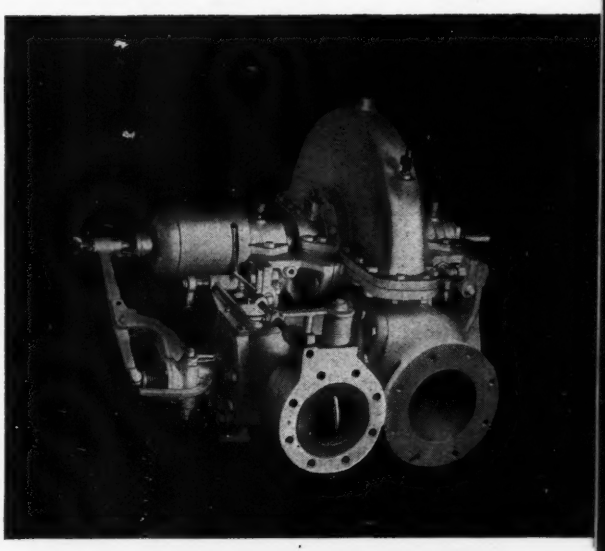
Steam Headquarters

PHONE - - *Steam Headquarters*

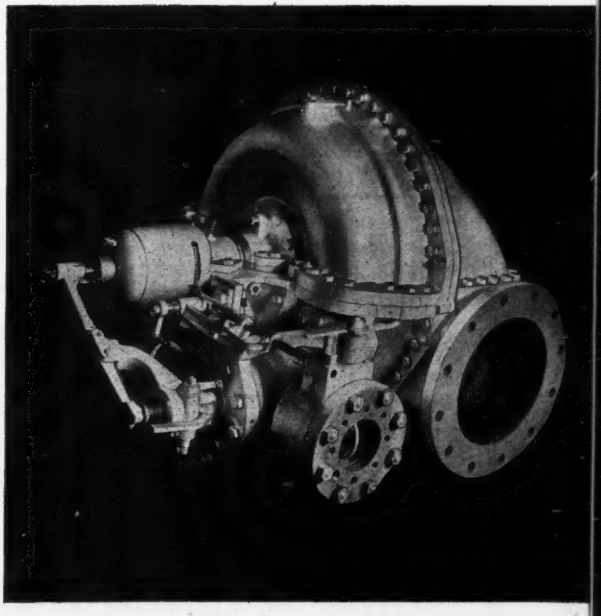
EXPERT DESIGN. Most mechanical drive turbines require only a small amount of special steam designing. But when unusual steam conditions are encountered, expert design help is necessary. Steam Headquarters maintains a permanent staff of steam design experts who daily engineer turbines for all varieties of conditions. Each Westinghouse turbine you buy is matched to its job.



NATIONWIDE SERVICE. Installing your turbine—getting it running—and KEEPING it running is the responsibility of our nationwide Steam Service. Westinghouse turbines are built to keep service requirements at minimum. But in an emergency, your Westinghouse Steam Serviceman is as near as your telephone—ready to act as turbine trouble shooter . . . anywhere . . . any time of night or day. J-50446



Type C-25 Single-stage General-purpose Turbine. Built for service up to approximately 1200 hp; speed range 1000-5000 rpm. Suitable for use with steam pressures through 600 lbs. gauge, and for total temperatures through 750° F.



Type C-225 Two-stage General-purpose Turbine. Built for services through approximately 1500 hp; speed range 1000-5000 rpm. Suitable for use with steam pressures through 600 lbs. gauge, and for total temperatures through 750° F.

Steam Headquarters

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Scovill Tube News

Vol. 2 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn. No. 3

Condenser Tube Installation Methods and Their Influence on Tube Life

Scovill engineers discuss the proper controls to prevent the most common troubles

The importance of proper tube installation in tubular heat exchangers has been repeatedly demonstrated both for new equipment and for retubing. Tube life and tube sheet life frequently have been shortened by the lack of proper control over the installation method. Distorted and cracked tube sheets; corroded, split, and cracked tubes — all have resulted from excessive or improper rolling or joint design.

As the importance of installation methods has become generally recognized, various controls have been developed to prevent excessive rolling — the most commonly encountered fault: —

1. Tubular "stops" are placed on the expander mandrel behind the carriage to prevent mandrel entrance beyond the desired point.
2. Limited pneumatic pressure is used for the operation of expander air motors.
3. Expanders are available fitted with cylindrical rolls, and with mandrels tapered in front and cylindrical at back. Tapered section of mandrel expands tube the desired amount, after which rolls slide over into cylindrical section of the mandrel and do no further work.

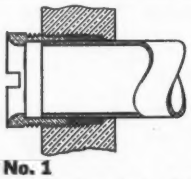
These and other methods are successfully used for *control* which is one of the primary requirements.

Scovill's tube engineers always have recognized the importance of proper installation on tube and unit life and have pioneered many of the improved tools and methods.

Since the tubular "stop" on the expander mandrel — as a means for controlling expansion — is simple, positive, applicable to all standard expanders, and calls for no specialized equipment, it has been used and widely recommended by us.

The following eight illustrations show methods of installation, and give a brief explanation of the advantages or disadvantages of each. More complete information is contained in "Scovill Condenser Tubes", a new edition of which will shortly be available.

Detail data given is authoritative for nonferrous tubes of common condenser tube sizes only (⅝" to 1¼" O.D. and 14 (.083") to 18 (.049") Ga.), but many of the details and practically all of the principles can and should be applied to other sizes and materials.

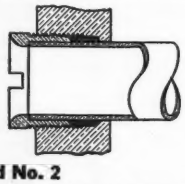


Method No. 1

Formerly the usual method of installing tubes in marine and stationary steam condensers. Inferior because of:

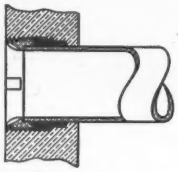
A. Protrusion into water box to create turbulence.

B. Pocket between inside shoulder of ferrule and tube end.



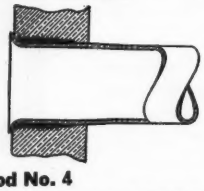
Method No. 2

Where protruding inlet end ferrules must be used, install as shown with the tube end fitted snugly into ferrule shoulder. Allow for expansion at the outlet end.



Method No. 3

This "flush-type ferrule"* can be installed as easily as the regular projecting type, but with this method, no inlet end air pocket is formed; and as there are no projections into the water box, turbulence is kept to a minimum.



Method No. 4

Recommended for renewing old tube sheets originally using ferrules. For this method a special bushing is inserted to replace the ferrule. The bushing is then reamed, radius cut, and grooved, after which the tube is expanded, flared, and beaded into position. See notes I, II, IV, V, VIII.

**Patented*

NOTES

I — Air entrained in the circulating water, or released from solution by turbulence or low pressure areas, frequently has a destructive effect on tubes. Streamlining of tube inlet ends reduces turbulence and minimizes the release of air from solution. This is of vital importance in steam condensers.

In oil refinery heat exchanger units, often operated under pressure, velocities are commonly so low, and impingement attack so uncommon, that tubes are satisfactorily installed by expanding without flaring or beading.

II — Reamed hole tolerances should not exceed plus and minus .002".

III — Locating inlet end of tube and avoidance of creep during expansion — any one of several methods may be used.

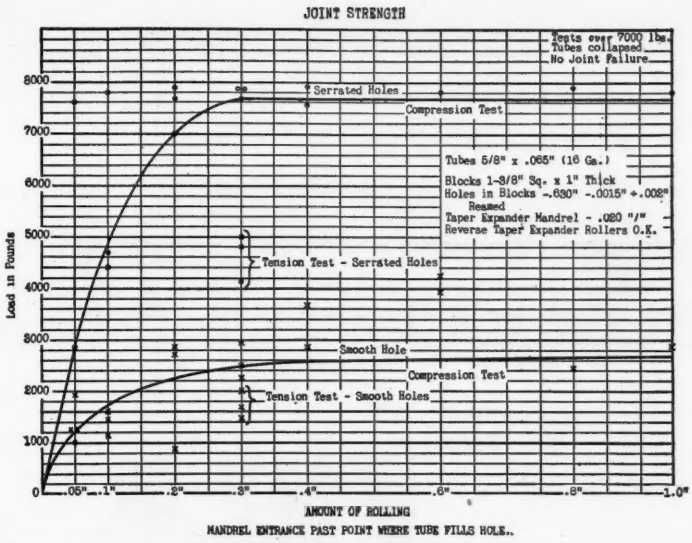
A. Scovill screw-in holding tool at outlet end, or Scovill combination tube puller and holder.

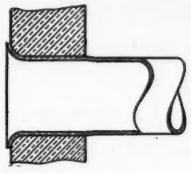
B. The outlet end, if to be expanded, may be rolled first, and the tube faced to length at the inlet end.

C. Expanders supplied by Scovill are recessed to receive the tube end and arranged to set the tube in the proper position where its location may be noted and held by a workman at the outlet end.

IV — Expanded length should extend through the tube sheet to prevent space between sheet and tube in which corrosive shell side media might collect, stagnate, and initiate active corrosion.

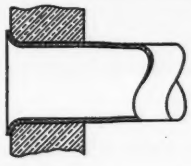
V — Expanded length should not extend beyond inner face of tube sheet, otherwise, an unsupported expanded section subject to stress corrosion or fatigue cracking will be created.





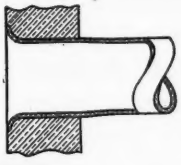
Method No. 5

Expanded to metal vs. metal joint with tube sheet. Tube sheet must be drilled, reamed, radius cut, after which the tube is expanded, flared, and beaded. This method is superior to methods No. 1 and No. 2. See notes I, II, III, IV, V.



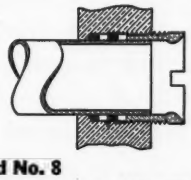
Method No. 6

In this method, the tube is expanded into a serrated hole which provides superior joint strength and permanence without excessive expansion. Tube sheet must be drilled, reamed, radius cut, grooved, after which the tube is expanded, flared, and beaded. See notes I, II, III, IV, V, VII, VIII.



Method No. 7

This is a refinement of method No. 6, but in method No. 7 the tube sheet has been recessed so that the beaded tube is flush with the tube sheet surface. This method requires that the tube sheet be drilled, reamed, radius cut, recessed, hole grooved, after which the tube is expanded, faced off to exact length if required, flared, and beaded. See notes I, II, III, IV, V, VII, VIII.



Method No. 8

This illustrates the use of Scovill's improved streamline ferrule for outlet end joints. It provides ample room for tube expansion, but the streamlined shoulder prevents the tube from dropping free of the inlet tube sheet. Although not illustrated, satisfactory outlet end joints can also be made without ferrules by the use of alternate rings of soft metal and fibre in the proper proportions.

VI — A short bevel or radius at inner face of tube sheet holes is recommended to minimize the potentially damaging effect of sharp edges against which vibration may occur and stresses concentrate.

VII — Allowance should be made for expansion and contraction of tubes due to thermal differentials in service. Various methods are used successfully.

A. Expansion joints in shell.

B. Floating heads (commonly used in small exchangers).

C. Bowed tubes — bow should be upward in order that tubes will drain when idle. This is frequently of great importance.

D. Tubes tight and fixed at inlet ends — pressure tight but free to slip at outlet ends (as with alternate rings of soft metal and fibre in proper proportions).

E. Tubes rolled at one end, then heated slightly over operating temperature and rolled at other end while hot. Tubes are then under slight tension when cold, but of proper length, and without stress while operating. The stress while idle has never, within Scovill's experience, caused trouble.

VIII — Serrated vs. smooth tube sheet holes. The advantage in joint strength obtained through the use of serrated tube sheet holes is clearly demonstrated in the chart in upper left corner.

TWO OTHER SCOVILL SERVICES —

The information in this article is illustrative of Scovill *Service in Manuals.* Other Scovill services welcomed by heat exchanger operators are *Service in Metals* — which means the facilities of our laboratories (as national needs permit) to help determine the best alloy for your conditions . . . and *Service in Men* — which means close cooperation from Scovill engineers in planning proper installation and in investigation where necessary.

For Scovill's new manual, advice on metals, or personal service of a Scovill engineer, address Scovill Manufacturing Co., 17 Mill St., Waterbury 91, Conn.

THIS IS NUMBER NINE in a Series of Scovill Advertisements to help you get longer life from condenser and heat exchanger tubes.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT . . . THREE SERVICES

Service in Manuals . . . Service in Metals . . . Service in Men

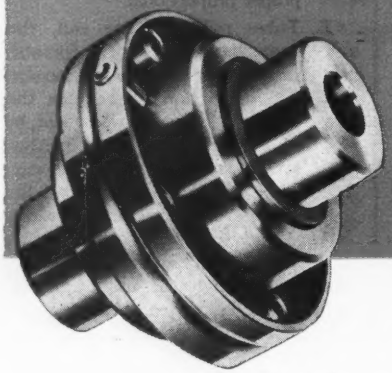
HIGH BOILER EFFICIENCY DESPITE SUDDEN LOAD CHANGES

DETROIT ROTOGRATE STOKER

AT THE

FALK CORPORATION

MILWAUKEE, WISCONSIN



The Falk Corporation are makers of the widely known Falk "Steelflex" coupling. Also, they build main propulsion reduction gear drives for all classes of vessels and other war products.

Detroit RotoGrate Stoker at The Falk Corporation is operated consistently at 14½% CO_2. The average monthly efficiency is 83.13%. Uniform steam pressure is maintained in spite of load changes from 50,000 to 77,000 pounds of steam per hour that occur when testing the reduction gears manufactured by them.

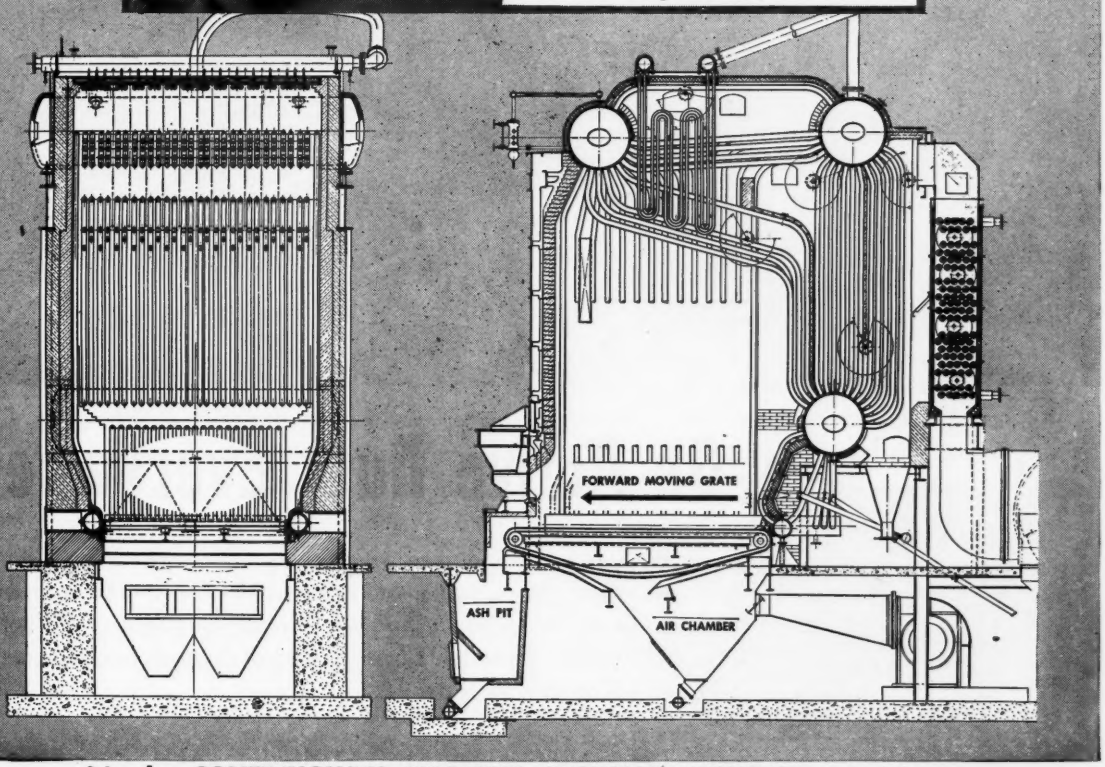
The RotoGrate is a CONTINUOUSLY CLEANING Spreader Stoker. The revolving Rotors distribute the coal uniformly in the furnace because they operate with an OVERTHROW ACTION. The fine particles of fuel are burned in suspension and the coarse coal on the grates.

A thick layer of ash protects the grates from the thin but uniform bed of fire, above. The ash is automatically discharged at the front end by the slow continuously FORWARD MOVING GRATE.

The RotoGrate may be the answer to your combustion problem. It provides a successful method for burning an extremely wide range of fuels. Write for catalog.

DETROIT STOKER COMPANY

Detroit RotoGrate Stoker at
The Falk Corporation, Milwaukee.

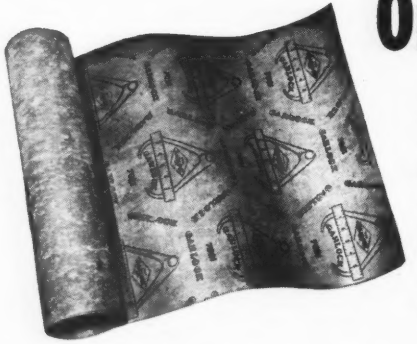


It's the CONTINUOUSLY CLEANING FORWARD MOVING grate that permits higher burning rates with fuels of either high or low ash content.

GENERAL MOTORS BUILDING • DETROIT 2, MICHIGAN

Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

On Active Duty Everywhere



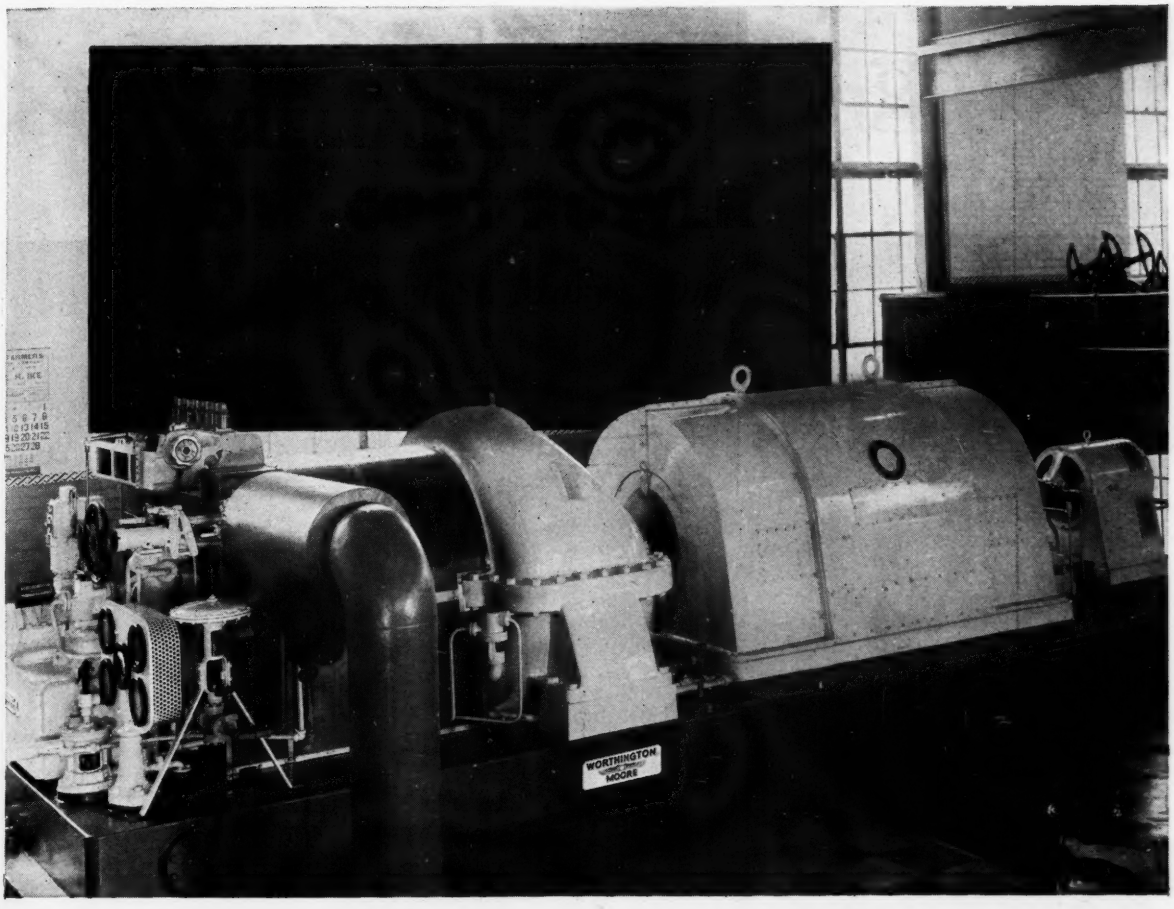
Both at home and abroad Garlock products are doing a job—on warships, planes, tanks and in industrial plants which are manufacturing war products and essential goods. Engineers everywhere rely on the dependable performance of Garlock packings, gaskets and KLOZURE oil seals.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada, Ltd., Montreal, Que.

GARLOCK 7021 Compressed Asbestos Sheet Packing is a superior gasketing material for severe conditions, such as super-heated steam at extreme pressures and light oils at high temperatures. Thicknesses $\frac{1}{64}$" to $\frac{1}{4}$". Sheets 40" x 40" and larger.

BUY MORE WAR BONDS

GARLOCK



Municipal Power Plants, especially those serving vital War industries, must have reliable and efficient turbo-generators. A representative Worthington-Moore installation is shown above.

This 2500 KW Worthington-Moore turbo-generator unit is installed in the Municipal Electric Light Plant in the City of St. Mary's, Ohio. The turbine operates on steam at 400# initial pressure, 750°F. total temperature and exhausts to 28" vacuum. Altho it is rated at 3125 KW maximum at Unity power factor, the unit has carried loads as high as 3400 KW.

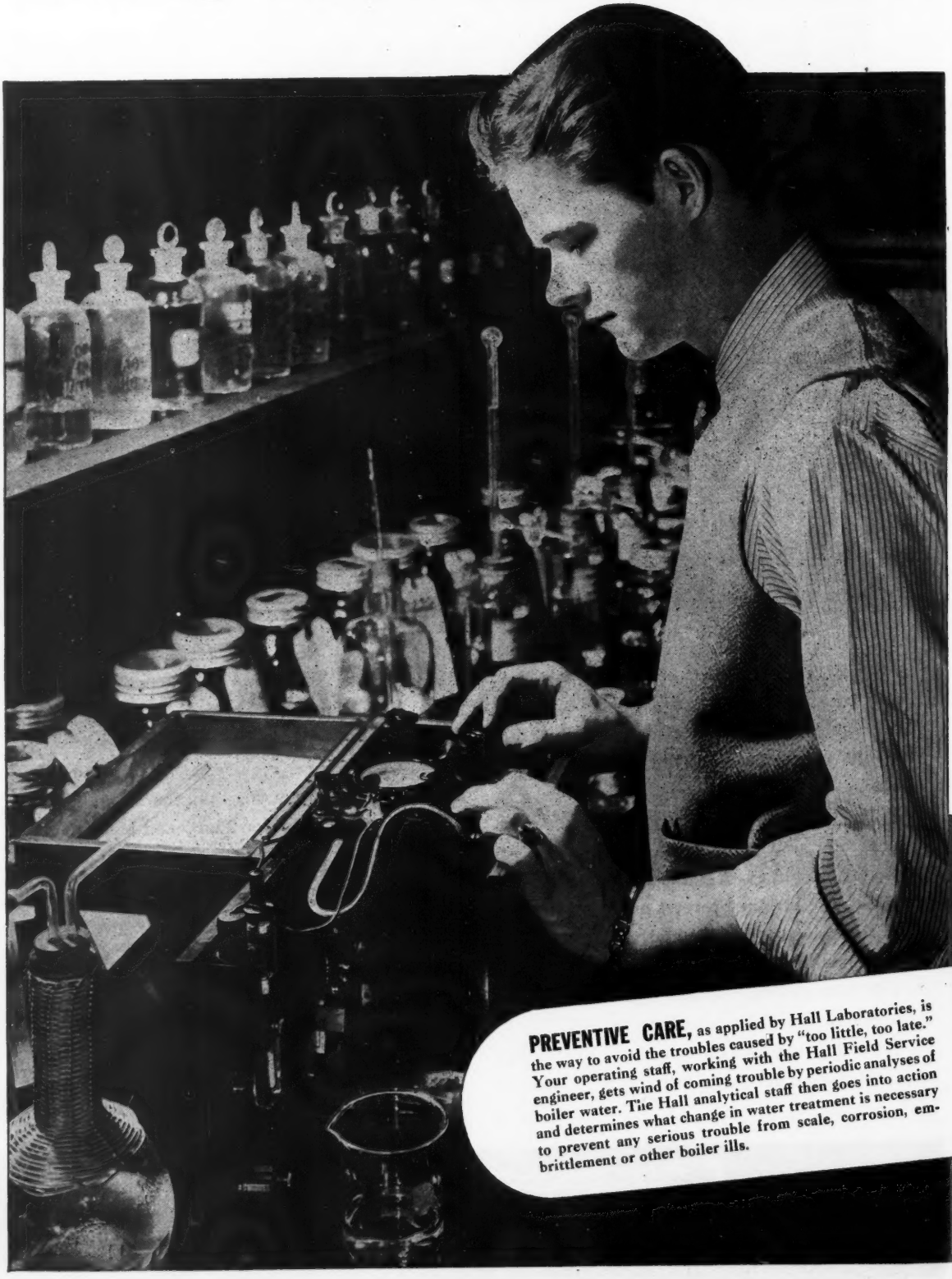
Making both single-stage and multi-stage turbines and turbo-generator sets . . . backed by Worthington's long experience in building equipment for the steam power plant, Worthington-Moore engineers are ready to study your power requirements and estimate your savings with a Worthington-Moore unit. Write us. Worthington Pump and Machinery Corporation, Moore Steam Turbine Division, Wellsville, N. Y.

BEHIND THE NAME
WORTHINGTON
MOORE

PRODUCTS OF WORTHINGTON

AIR CONDITIONING EQUIPMENT • REFRIGERATION AND ICE PLANT EQUIPMENT • AIR AND GAS COMPRESSORS • STEAM TURBINES • DIESEL ENGINES • GAS ENGINES • CONVERTIBLE GAS-DIESEL ENGINES • CENTRIFUGAL HIGH-PRESSURE BOILER FEED PUMPS • DIRECT-ACTING STEAM PUMPS POWER AND ROTARY PUMPS • TURBINE WELL, SUMP AND DRAINAGE PUMPS • STEAM CONDENSERS AND AUXILIARIES • VACUUM PUMPS • STEAM-JET EJECTORS • WATER PURIFICATION EQUIPMENT • PORTABLE COMPRESSORS AND AIR TOOLS — For street . . . trench . . . conduit service V-BELT DRIVES • LIQUID METERS

Doing "too little and



PREVENTIVE CARE, as applied by Hall Laboratories, is the way to avoid the troubles caused by "too little, too late." Your operating staff, working with the Hall Field Service engineer, gets wind of coming trouble by periodic analyses of boiler water. The Hall analytical staff then goes into action and determines what change in water treatment is necessary to prevent any serious trouble from scale, corrosion, embrittlement or other boiler ills.

too late" invites failure in the boiler room

CHANCES are you have never been faced with a boiler tube failure that could not be traced to doing too little and too late. Every time it happened you probably made up your mind that you would not let it occur again—but it did. That is, unless you had become a convert to *preventive care.*

Preventive care, as applied by Hall Laboratories, has probably been responsible for keeping more boilers on the line during this war emergency than any other thing. If its practice had been known during World War I, we would never have had such a tragic history of power failure.

Today, power plant engineers know that the right way to lick the problems of scale, corrosion, embrittlement and carryover is to hit them before they start. And they recognize the need for help from the trained specialist.

From its beginning, Hall research has been concentrated on finding the causes of boiler ills and what to do to prevent their occurrence. That is why Hall Laboratories has enjoyed such a distinguished record of success. Trained in the details of accurate diagnosis, the Hall field engineer sets up a program of preventive care which will meet your own plant's particular needs. If your plant is in trouble now, he will work with you to correct it. From that time on moderate supervision is all your plant will need.

Supporting these field men is the finest equipped laboratory in the world devoted exclusively to the solution of boiler water problems. Many of the important advances in the science of industrial water conditioning owe their origin to the pioneers who man its staff.

It is never too late to start practicing preventive care. May we tell you more about it?

HALL LABORATORIES · HAGAN BUILDING · PITTSBURGH 30, PA.

A Subsidiary of Hagan Corporation

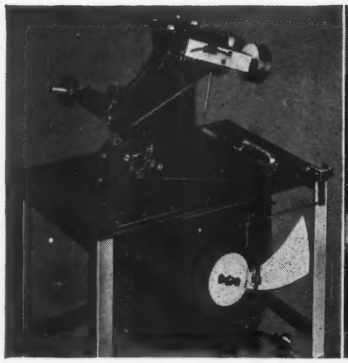
HALL SYSTEM *of Boiler Water Conditioning*

HAGAN
HALL
BUROMIN
CALGON

Hall Service in a Nutshell

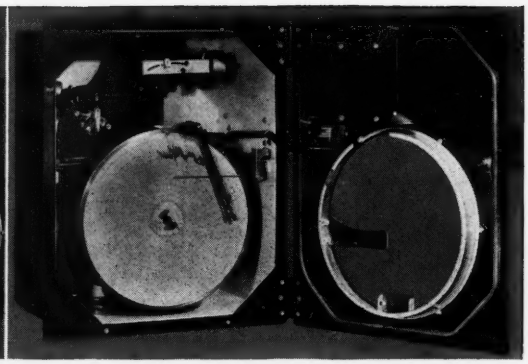
At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. Minimizes boiler outages caused by water.
2. Helps maintain highest efficiency.
3. Establishes non-embrittling water.
4. Minimizes carryover.
5. Prevents corrosion in boilers and associated equipment.
6. Prevents deposition in water lines and cooling systems.



Meter assembled as one unit on rack ready for calibration.

Meter assembly can be easily removed from the case.



Meter with door open showing accessibility of all adjustments and working parts.

Republic Boiler Meter

ON ONE CHART ○

STEAM FLOW
AIR FLOW
TEMPERATURE
OR PRESSURE

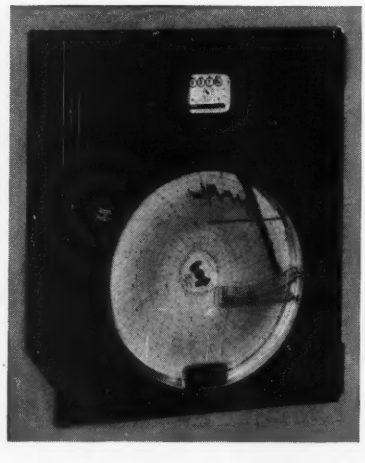
★ The new Republic Boiler Meter provides, in one instrument and on one chart, all the essential information concerning boiler performance regardless of the size or type of boiler, kind of fuel or method of firing.

The meter indicates, records, and integrates steam flow from the boiler and records rate of air flow for combustion. When the correct amount of air for maximum combustion efficiency is being supplied the air flow pen will record coincident with the steam flow pen, regardless of the load being carried by the boiler.

A third pen recording flue gas temperature (or steam pressure) can be added thereby providing the operator with complete information, on one 12-inch chart, relative to the performance of the boiler at any given time.

The Republic Boiler Meter consists of a standard Republic electric steam flow recorder and integrator and an oil sealed, bell type air flow element.

The air flow element consists of an oil sealed bell in a sealed chamber. The motion of the bell is transmitted through a diaphragm seal. This arrangement permits the use of a single bell—the high pressure being applied to the top of the bell and the low pressure under the bell. This arrangement also excludes air and dirt from the oil. The motion of the bell is transmitted to a cam system which extracts the square root, or when adjusted for a particular installation, compensates for chimney action and variable excess air requirements. The air flow pen is attached to the cam system with an adjustable linkage which permits changing the steam flow air flow ratio as conditions may require.



The entire operating mechanism is housed in a rugged steel case and can be easily removed as a single unit by merely loosening two anchor bolts and disconnecting the two air connections. The meter may be either wall mounted or flush mounted on a steel panel. *Write for Bulletin No. 420.*

REPUBLIC FLOW METERS CO.

2224 DIVERSEY PKWY. CHICAGO 47, ILLINOIS

A-C HIGH PRESSURE PUMPS SET RECORD IN TOLEDO FIRE

THIS PICTURE was taken 30 minutes after a 4-alarm fire broke loose in mid-town Toledo. *Greatest drain in history* of high pressure pumping station was reported when, during a 2-hour period, *all four* Allis-Chalmers fire pumps serving the station were in operation *at one time.* The pumps, installed in 1915, are 10" by 10", 5-stage units rated at 2000 gpm, 300 lbs. pressure each.

Photo Courtesy of Toledo Blade

TOLEDO, OHIO—2,400,000 gallons of water were pumped through local high pressure mains during a 6-hour period . . . shattering previous records. Pumpage was at a rate of 7,800 gpm, compared to previous high of 5,100 gpm. Four Allis-Chalmers High Pressure Fire Pumps set this new record after 29 years of service. That indicates dependability and durability — the kind of quality built into every A-C pump. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1737

ALLIS-CHALMERS CENTRIFUGAL PUMPS

Next time you need pumps — 10 to 150,000 gpm, heads to 2500 lbs. — call on Allis-Chalmers!

*Extreme

TIDE WATER LUBRICANIA

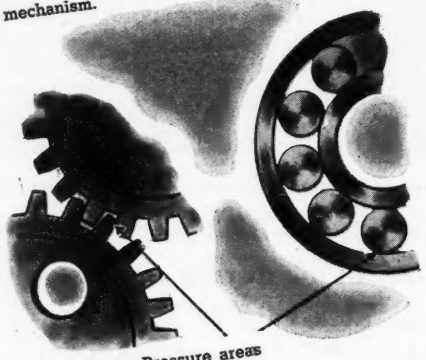
DEFINITION: Extreme Pressure Lubricants are mineral oils or greases compounded with certain additives, which give the lubricants the property of "greatly increased load-carrying ability." (The slight increase in load-carrying ability which occurs when fatty oils are added to mineral oils is not sufficient to justify such products being termed Extreme Pressure Lubricants.)

EXPLANATION: Mechanisms such as gears, anti-friction bearings operate with both a rolling and rubbing action. The areas of contact between the gear teeth, or in the case of the anti-friction bearings, between the rolls or balls and their races, are extremely small, hence unit pressures may become very great, often in the region of four or five hundred thousand pounds per square inch. Under these conditions of loading, and as rubbing velocities increase, mineral oils regardless of viscosity are unable to maintain an unbroken fluid film of oil between the relatively moving parts. The metals in contact each being made of steel are not in themselves good bearing surfaces. The result is that when metal to metal contact occurs, high local temperatures develop, resulting in incipient welding of the metal parts in contact. As motion continues, they tear apart resulting in scored surfaces on the gear teeth, rolls, balls or races.

By adding certain compounds to the oil (usually compounds containing sulphur, chlorine or phosphorus), an "Extreme Pressure Lubricant" is evolved. When sufficient local heat is developed by contact of the steel surfaces, the additive in the Extreme Pressure Lubricant decomposes. The active ingredient is liberated and immediately reacts with the steel surfaces at points of contact, forming a new and softer surface — viz., Iron Sulphide, Chloride or Phosphide as the case may be. These newly formed surfaces, being relatively soft act as excellent bearing surfaces in themselves and become self-lubricating. They also act as an anti-flux and prevent any tendency towards incipient welding.

Provided the heat in these parts can be quickly removed so that the newly formed surfaces are not destroyed, and this is accomplished by the liquid lubricant surrounding them, excellent performance under Extreme Pressure operation is obtained.

NOTE: Extreme Pressure Lubricants do not perform as such between bearing surfaces other than steel on steel. For the lubrication of worm gear drives, where bronze on steel is utilized, the relatively soft and good bearing metal "bronze" operating against the harder "steel" provides an excellent condition of "solid lubrication". This only requires a lubricant that quickly removes heat and prevents softening of the bronze. A straight mineral oil or a mineral oil containing a small quantity of fatty oil is the lubricant most generally used in this type of mechanism.



Extreme Pressure areas

INDUSTRIAL TYCOL OILS-GREASES

Gasoline Powers the Attack — Don't Waste A Drop

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE **TYCOL**

PRESSURE

* This is the 11th of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

DRUMS! DRUMS! DRUMS!
War needs make it extremely important that all empty drums be returned immediately.

Whatever your lubricating need – extreme pressure, high or low temperature, high speed, or any other service condition – there's a Tycol oil or grease exactly suited to your specific need.

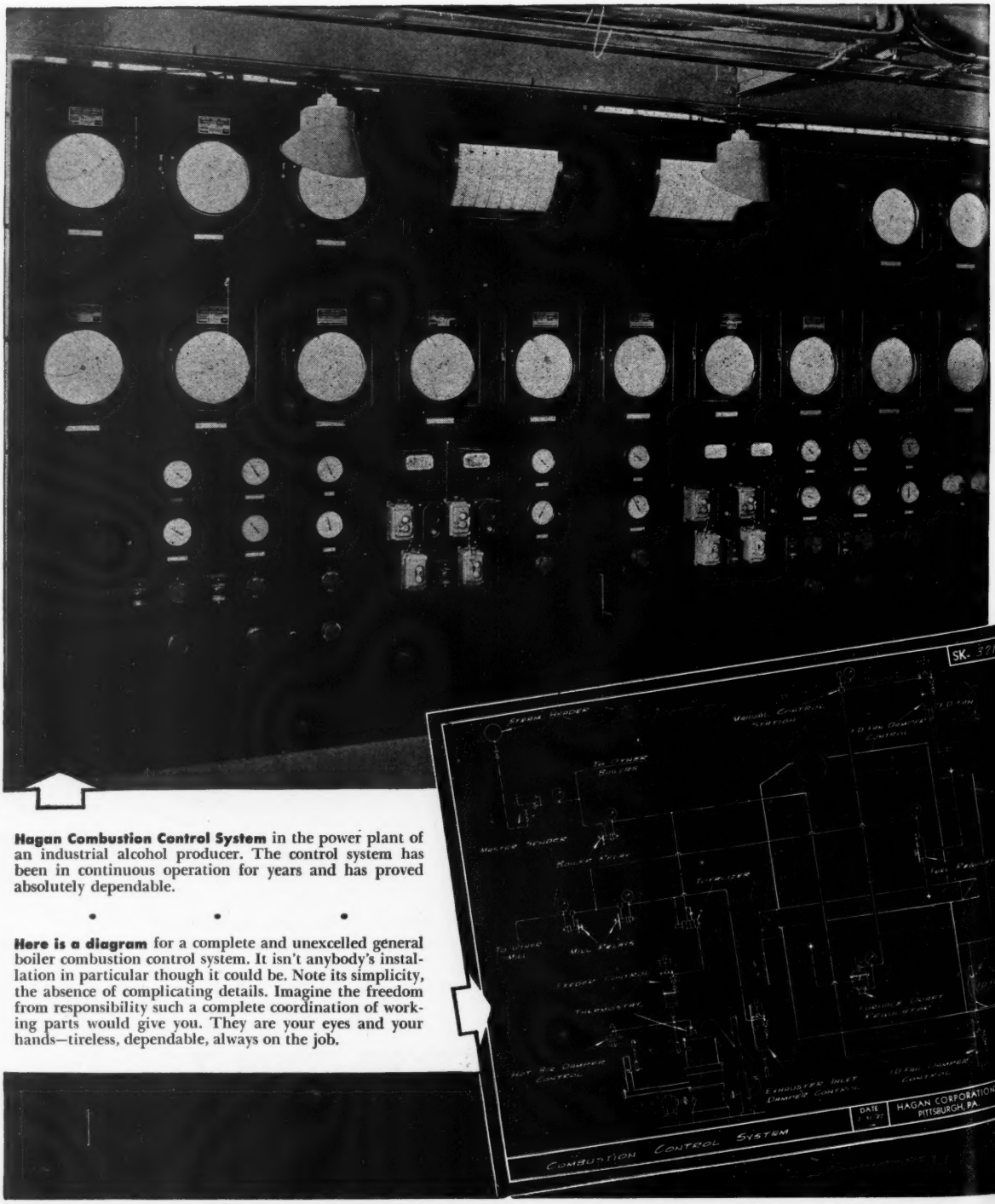
Tide Water Engineers will recommend the Tycol lubricant that meets your particular requirements. Call or write your nearest Tide Water office.

TIDE WATER ASSOCIATED OIL COMPANY

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL • Eastern Division: 17 Battery Place, New York 4, N. Y.
Principal Branch Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

INDUSTRIAL LUBRICANTS

Write your own



Hagan Combustion Control System in the power plant of an industrial alcohol producer. The control system has been in continuous operation for years and has proved absolutely dependable.

• • •

Here is a diagram for a complete and unexcelled general boiler combustion control system. It isn't anybody's installation in particular though it could be. Note its simplicity, the absence of complicating details. Imagine the freedom from responsibility such a complete coordination of working parts would give you. They are your eyes and your hands—tireless, dependable, always on the job.

Specifications

FOR COMBUSTION CONTROL

. . . and see how closely . . they are met by Hagan!

SUPPOSE you were to put down on paper your own conception of what an ideal system of Automatic Combustion Control should offer. It would look something like this.

1. It should be simple and foolproof. Hagan Control operates on a simple pneumatic system. The slightest or the most sudden change in steam pressure starts a chain of operations which quickly restores steam pressure to normal. This is all automatic and foolproof. No operator needs to watch instruments or make adjustments.

2. It should be absolutely dependable. Hagan Control is as carefully engineered as any machine. It does not depend on fragile instruments for its operation. Some of the first units of Hagan Control installed 25 years ago are still in daily service.

3. It should be accurate and flexible. Hagan Control is designed to operate accurately and quickly without "hunting." It is flexible in operation so that it can be used for any type of fuel with equally good results.

4. It should be economical with fuel. Fuel savings up to 10% are not unusual with Hagan Control. There are many cases where higher savings have been made. The general use of automatic combustion control in power plants has been a major factor in relieving fuel shortages in this war.

5. It should give uninterrupted service. Hagan Control is designed to stay in continuous operation in hot, dirty locations. It is built ruggedly and requires little maintenance or adjustment.

Find out about Hagan Control. It is used not only for boilers, but is also applied to all types of industrial furnaces, steel mills, and chemical processes.

HAGAN CONTROL ASSURES

MAXIMUM quantity of steam from any given plant, by introducing fuel and air in correct proportion for utmost efficiency.

MAXIMUM utilization value of steam, uniform steam pressure and temperature.

MAXIMUM output from boilers of differing capacities, automatically.

MAXIMUM steam for production, by reducing loss of steam in frequent soot blowing.

MAXIMUM protection of auxiliary equipment, fans, stokers, etc., by maintenance of uniform operating conditions.

HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

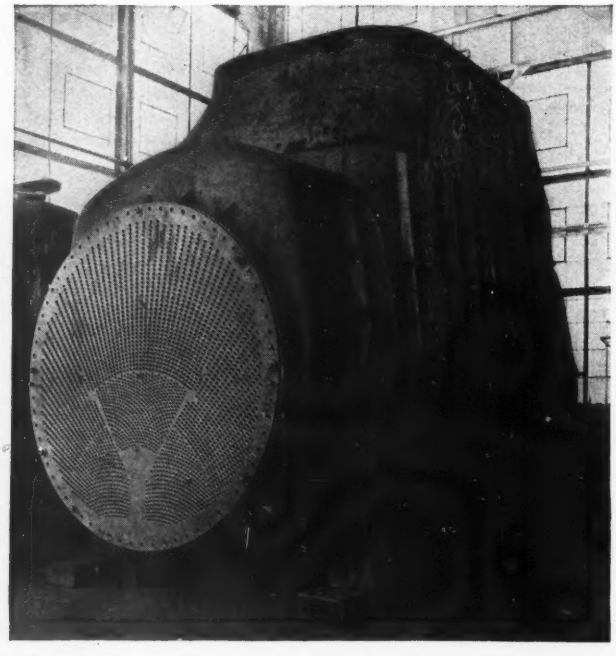
Blazing THE

Condenser

RADIATING TUBE ARRANGEMENT

★ In 1924 the first condenser with tubes arranged on radiating straight lines was put into operation at the plant of the Rockford Electric Company, Rockford, Illinois. Since then, this fundamental improvement in design has gained wide acceptance . . . and is used in more than one thousand condensers constructed by Foster Wheeler alone.

Steam lanes of uniformly decreasing area are provided between the rows of tubes. This design effects a high rate of heat transfer throughout the condenser and offers minimum resistance to steam flow.



First condenser designed and constructed with tubes arranged on radiating straight lines.

Foster Wheeler is a Three Star winner under the U.S. Navy Board of Awards for production.

FOSTER WHEELER CORPORATION

165 BROADWAY
NEW YORK 6, N. Y.

FW FOSTER W

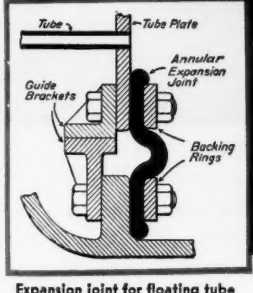
ENGINEERING TRAIL

Development

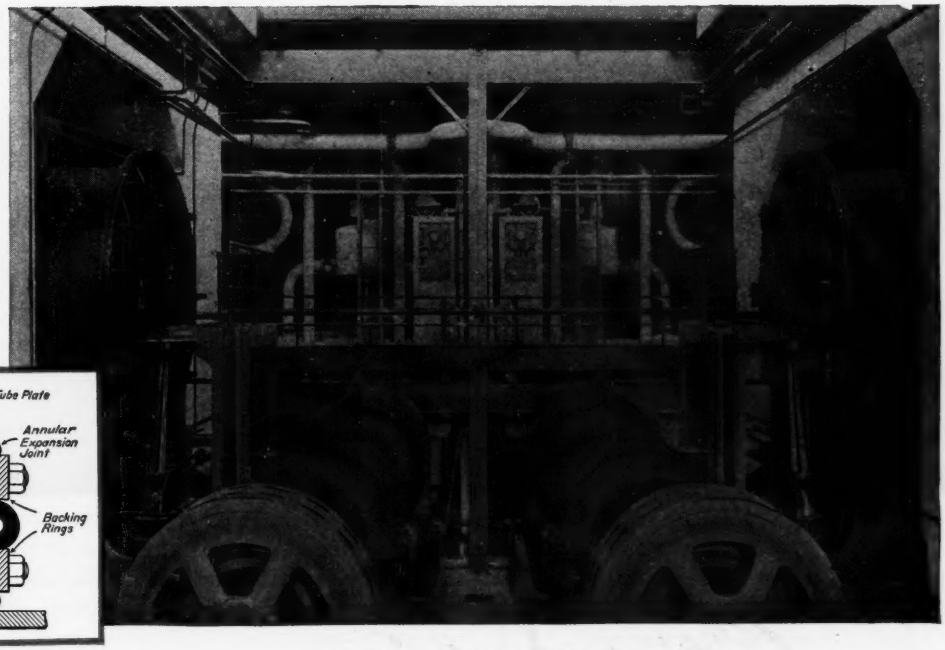
EXPANDED TUBES

★ The first surface condenser to have all tubes expanded into tube sheets at both ends was designed and built by Foster Wheeler twenty-one years ago for the Texas Power and Light Company, Trinidad, Texas. This construction insures permanently tight joints to eliminate contamination of condensate by the circulating water.

Performance of this installation was so eminently satisfactory, showing far greater purity of condensate than obtained from other designs, that the principle of expanding condenser tubes at both ends has since become a standard practice.



Expansion joint for floating tube sheet condensers used in the Trinidad units and in many of today's designs.



Condensers of the Trinidad Station of Texas Power and Light Company were the first to have all tubes expanded into tube sheets at both ends.

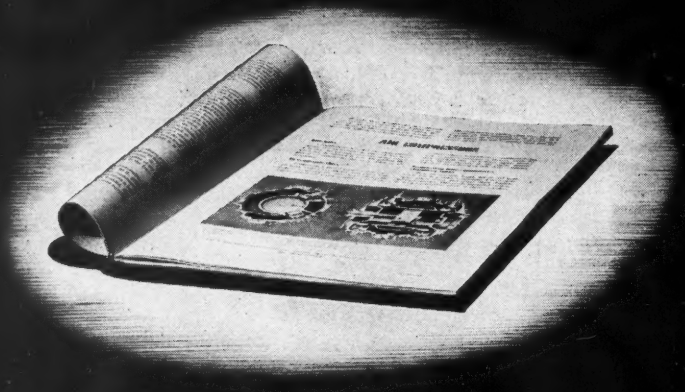
WHEELER FW

EXAMPLE OF *Service*:

Adiabatic and Isothermal Compression (page 9) . . . Moisture and Dew Point (page 30) . . . Cylinder Clearance (page 10) . . . Sludge Formations (page 34) . . . These are just a few of the important subjects discussed in our handsome new booklet, AIR COMPRESSOR LUBRICATION.

Clearly illustrated, packed with helpful information, it's free to air compressor owners and their personnel.

Simply write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.



More and more, it's service that counts . . .

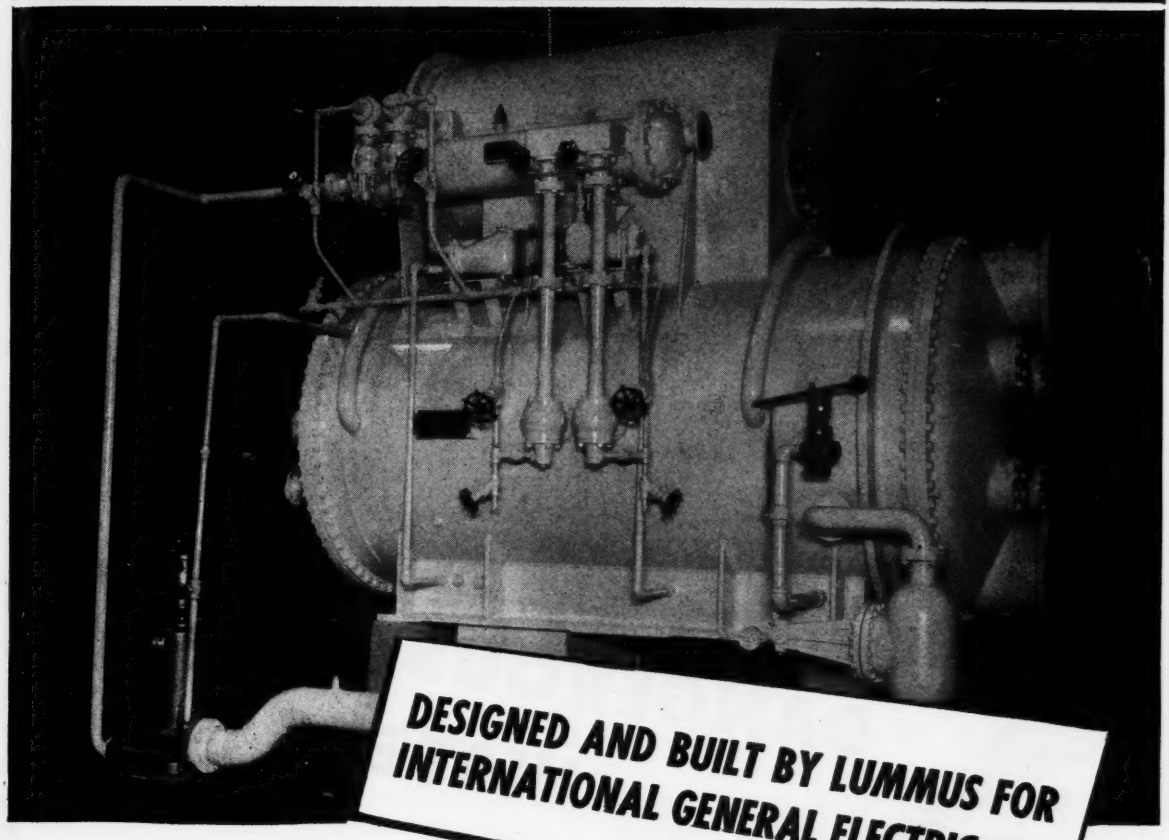
and *Cities Service* means good service!

CITIES SERVICE OILS — ONCE-ALWAYS

CITIES SERVICE OIL COMPANY

ARKANSAS FUEL OIL COMPANY

3,000 kw package type surface condenser



DESIGNED AND BUILT BY LUMMUS FOR INTERNATIONAL GENERAL ELECTRIC CO.

Shipped complete . . . ready for installation on a mobile power train . . . this 3,000 kw package type surface condenser is one of forty designed and built by Lummus for the International General Electric Company.

Among the interesting features of design and construction are . . . tube sheets welded to the shell of the condenser, eliminating two packed joints (sources of possible air leakage) . . . complete deaeration of condensate in the hot well through the introduction of exhaust steam in the deaerating system . . . air ejector set, designed and built by Lummus is an integral part of the package unit.

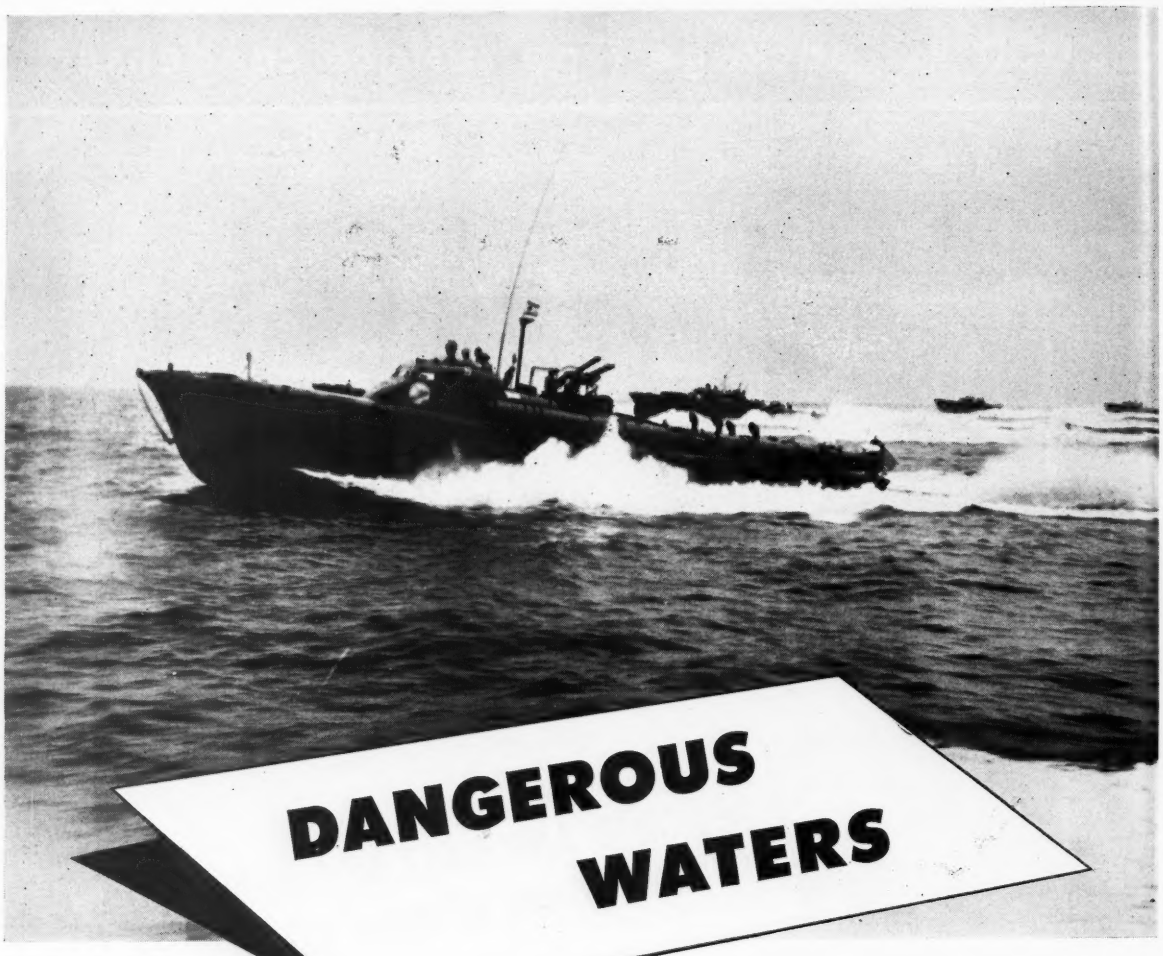
Lummus designs and builds a complete line of surface condensers and other heat exchange equipment for stationary, marine, and refinery applications. Write for complete data.

Lummus Power Plant Equipment

- Surface Condensers
- Steam Jet Air Ejectors
- Bleeder Heaters
- Boiler Blowdown Heat Exchangers
- Evaporators
- Fuel Oil Heaters
- Lubricating Oil Coolers

THE LUMMUS COMPANY • 420 LEXINGTON AVE., NEW YORK 17, N.Y.

LUMMUS



● The best defense is a well organized offense . . . whether waging a war in dangerous waters or fighting water problems in industrial production.

Water . . . unconditioned . . . when carried to vital spots in your plant, can waste fuel, increase labor costs, ruin vital equipment and wreck production schedules.

Today, effective water conditioning is a "must" in the battle against scale, corrosion, embrittlement, oil, etc.

You are invited to call on Infilco's Engineering staff to help in any problem of boiler or evaporator feedwater treatment, cooling water conditioning, condensate oil removal, steam purification, trade waste treatment, etc.

INFILCO
INCORPORATED

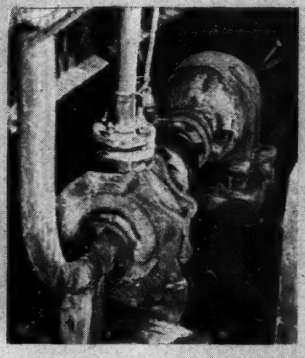
325 W. 25TH PLACE, CHICAGO, ILL.

INFILCO

ACCELATOR SOFTENERS • CHEMICAL FEEDERS • PROPORTIONERS
WATER FILTERS • CLARIFIERS • COOLING WATER CONDITIONERS
CONDENSATE FILTERS • STEAM PURIFIERS • HOT-FLOW SOFTENERS
LIME-SODA SOFTENERS • ZEOLITE SOFTENERS • CATEXERS

ARMY NAVY

DOSE OF SALT

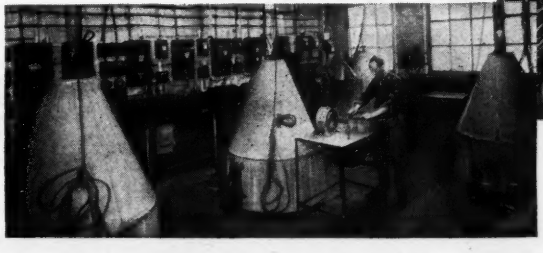


Encrusted with chemical salts, this Tri-Clad motor continues to drive a pump without breakdown of its insulation. In almost every industrial plant, motors are called upon to keep going under conditions which try their endurance to the limit. It may be in a plating room, or on an exhaust fan, or in a wet sub-cellar, or — as in this case — in connection with chemical processing. In emergencies, open motors may face conditions for which good engineering practice would require totally enclosed construction — conditions which tend to corrode the frame and attack the insulation. Endurance of Tri-Clad motors under such conditions results from tests like the one described below.

Salt-spray test of TRI CLAD motors gives assurance of long life in severe service

IN this accelerated life test to determine the ultimate endurance of their insulation, the motors are operated to failure under one of the worst possible combinations of conditions. They are continually exposed to a 2% salt-water spray, while operating on a duty cycle of 3 minutes on and 37 minutes off. (These repeated voltage surges impose greater stress on the insulation than would continuous operation.) Tests are run on all new insulations developed, and as a production check on motors taken at random off the assembly lines. Because of their endurance under this severe test, among others, Formex* wire and Glyptal* bonding material were chosen for Tri-Clad insulation.

*Reg. U.S. Pat. Off.



Left: Conical hoods cover the tanks in which these salt-spray tests are conducted.

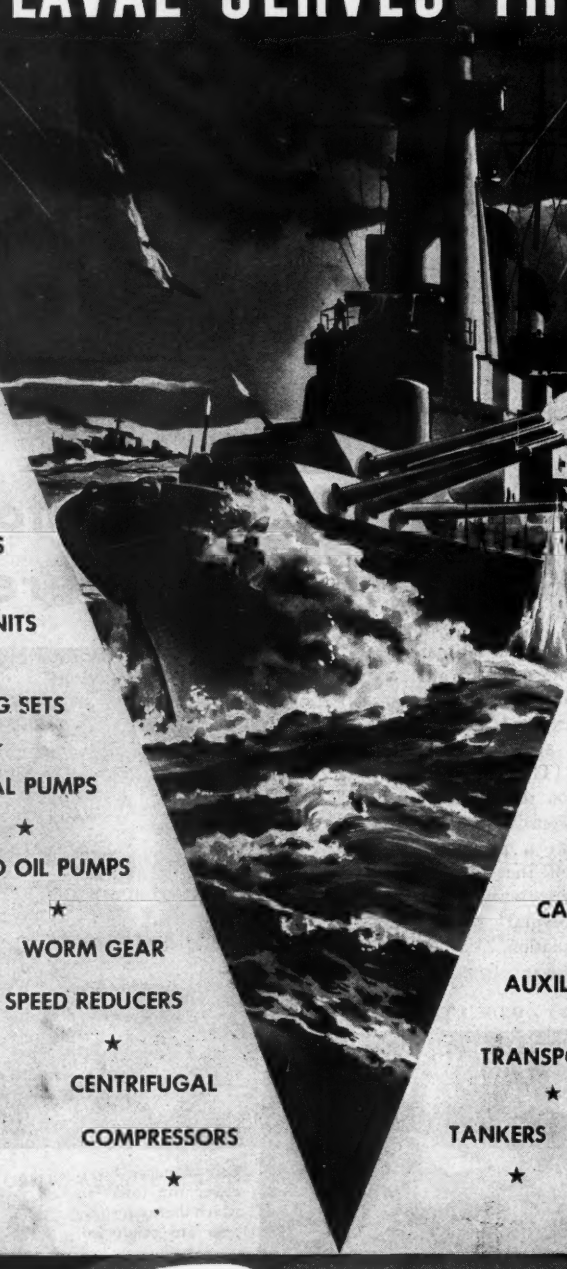
GENERAL ELECTRIC

TRI CLAD MOTORS

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

...through the years

DE LAVAL SERVES THE NAVY



REDUCTION GEARS ★ TURBINES ★ PROPULSION UNITS ★ GENERATING SETS ★ CENTRIFUGAL PUMPS ★ IMO OIL PUMPS ★ WORM GEAR SPEED REDUCERS ★ CENTRIFUGAL COMPRESSORS ★

BATTLESHIPS ★ AIRCRAFT CARRIERS ★ CRUISERS ★ DESTROYERS ★ DESTROYER ESCORTS ★ SUBMARINES ★ CARGO SHIPS ★ AUXILIARY SHIPS ★ TRANSPORTS ★ TANKERS ★

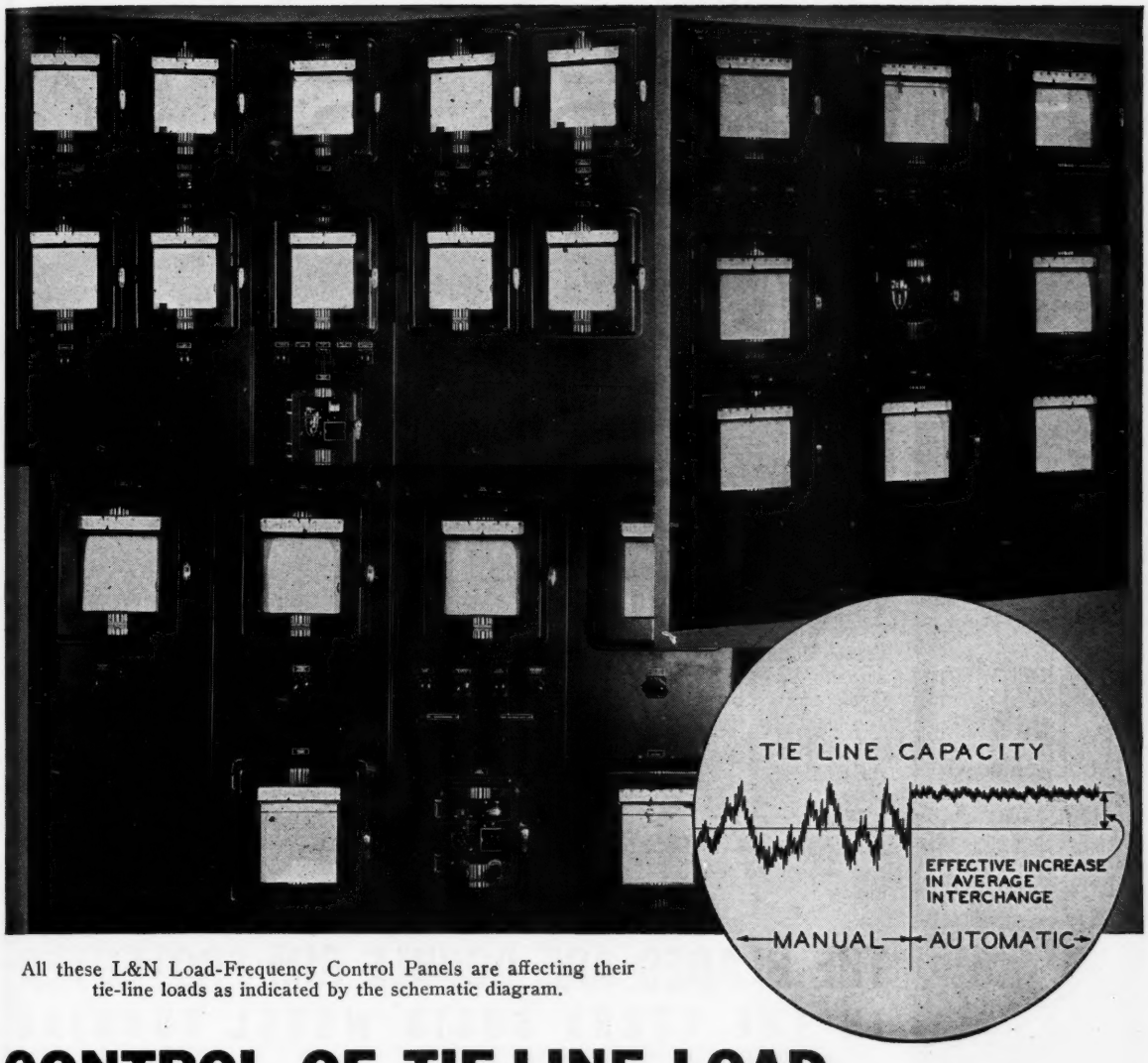
M-43

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

De Laval

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

SALES OFFICES: ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER DETROIT • DULUTH • EDMONTON • GREAT FALLS • HAVANA • HELENA • HOUSTON KANSAS CITY • LOS ANGELES • MONTREAL NEW ORLEANS • NEW YORK • PHILADELPHIA PITTSBURGH • ROCHESTER • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE TORONTO • TULSA • VANCOUVER • WASHINGTON, D. C. • WINNIPEG



All these L&N Load-Frequency Control Panels are affecting their tie-line loads as indicated by the schematic diagram.

CONTROL OF TIE-LINE LOAD IS LIKE "FINDING" A GENERATOR

The effective carrying capacity of a tie-line is increased, instantly and permanently, when the switches are thrown to turn load-frequency regulation over to the appropriate battery of L&N instruments.

There's no mystery about how the result is achieved; it's simply because all significant facts concerning interchanges and outputs are telemetered to the system-regulating point or points, where the fully-automatic instruments are fast, sensitive and accurate enough to execute the dispatchers' wishes more closely than men could execute them. The average of tie-line load rises toward the line's capacity; the line carries more load; the effect is the same as though another generator has been found and put to work.

And this is not only in isolated cases; it is being attained in war-busy power centers all over the country. We show above just a few of the panels we have recently supplied for this service; each designed after conference with the operating engineers concerned; each built to help that one network carry its load more effectively.

For a description of the equipments, see Technical Publication N-56-161(1). For data on a specific problem, please write outlining the situation.

Jrl Ad N-56-161(4)

I depends on me!

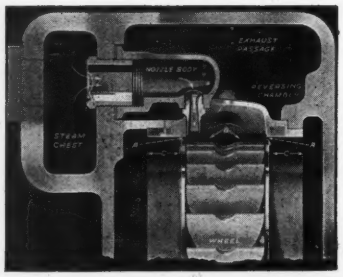
A Slogan For Every American

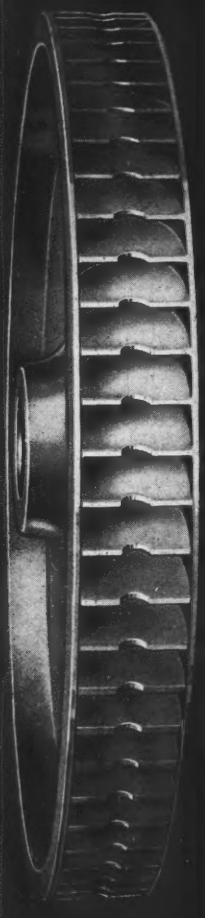
LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA., PA.

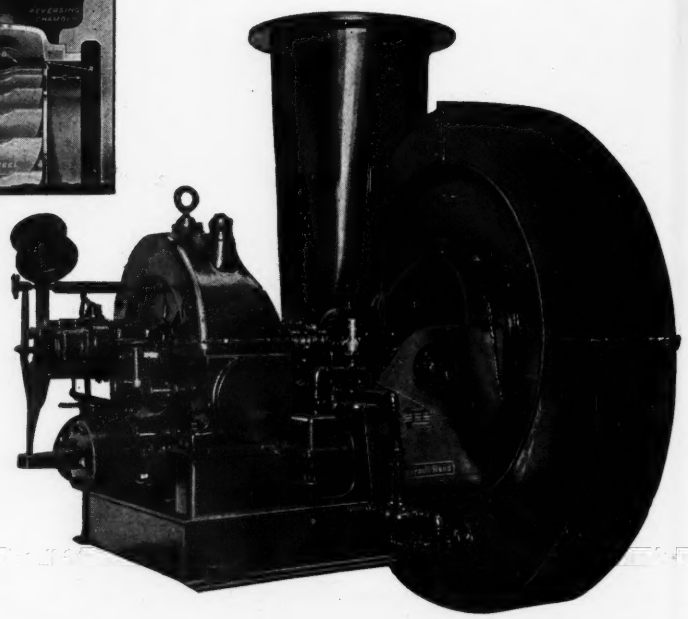
LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

TERRY







ABOVE:

Terry Wheel Clearances. A—Rim Clearance. B—Large Blade Clearance. C—Side Clearance (about one inch).

AT RIGHT:

Typical Terry Solid Wheel Turbine direct connected to a blower.

THE BLADES ARE DOUBLE RIM PROTECTED IN THE TERRY SOLID WHEEL TURBINE

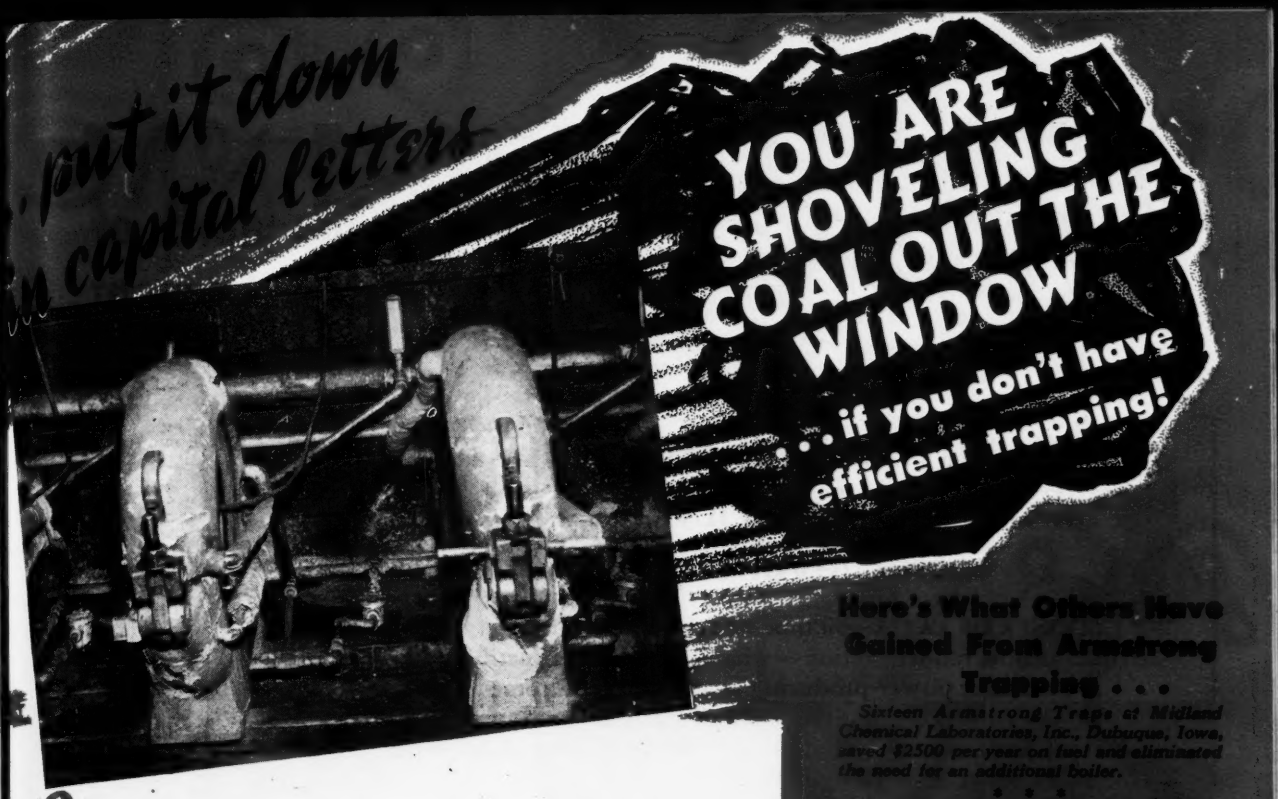
In the Terry Turbine the blades have large clearances and are further protected by the projecting rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the radial clearance became reduced.

End play can do no damage to the blading as the side clearance is very large (about one inch). There is no end thrust since the steam enters and leaves the wheel in a direction at right angles to the shaft.

The Terry solid wheel turbine is described in our Bulletin S-116.

A request on your business letterhead will bring a copy.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



PROBABLY the biggest single source of fuel waste is inefficient trapping. This is not hard to realize when you consider that one leaky trap at 100 lbs. pressure could waste as much as 25 lbs. of steam per hour. Multiply this by the number of traps in an average plant and the figures can become staggering. In addition, steam leakage increases back pressure and reduces system capacity.

Armstrong Traps will save you these irrecoverable steam and fuel losses for the following reasons:

STEAM TIGHT VALVES. Armstrong valve parts remain steam tight for a long time. This is due to such design and construction features as:

1. Valves and seats are water-sealed at all times.
2. Valves and seats are made of chrome steel. The parts are heat treated after machining. The ball valves are precision ground. Valves and seats are lapped together. Fussy operations, but they pay in steam savings.
3. Free floating lever design lifts valve to seat without leverage, thereby minimizing wear.

AUTOMATIC AIR ELIMINATION. This saves steam in several ways:

1. No manual blowdown necessary to rid pipe or steam heated unit of air.
2. Bypass valves not needed with Armstrong Traps. A bypass valve left open accidentally or on purpose will shrink boiler capacity a lot.
3. By keeping air out of steam heated process equipment, work can be done in a shorter time, thereby reducing non-productive radiation losses.

SELF-SCRUBBING ACTION. This saves steam because:

1. It prevents accumulation of dirt which would interfere with trap operation.
2. Dirt will not lodge between valve and seat to prevent tight closing of the trap valve.

If you'd like to maintain present or higher production with less fuel consumption, let an Armstrong representative help you improve your trapping. He's an experienced sales engineer who has mastered trap selection and installation problems. He sells Armstrong Traps on a "satisfaction or your money back guarantee". Write for his name today!

ARMSTRONG MACHINE WORKS
810 Maple St., Three Rivers, Michigan

Here's What Others Have Gained From Armstrong Trapping . . .

Sixteen Armstrong Traps at Midland Chemical Laboratories, Inc., Dubuque, Iowa, saved $2500 per year on fuel and eliminated the need for an additional boiler.

* * *

British Columbia Packers, Ltd., cut fuel costs $250 per year, more than double the cost of the Armstrong Traps installed on steam coils of settling tanks.

* * *

Northwestern Stove Equipment Corporation, Milwaukee, saved 170 tons of coal per year after installing Armstrong Traps on wood drying kilns and on the low pressure heating system.

* * *

The Lord Baltimore Hotel, Baltimore, found steam savings amounted to 13% after Armstrong Trapping of laundry and kitchen equipment.

TABLE A
Cost of various sized steam leaks at 100 pounds pressure (assuming steam costs .50c per 1000 lbs.)

Size of Orifice	Lb. Steam Wasted Per Month	Total Cost Per Month	Total Cost Per Year
1/2"	835,000	$417.50	$5,010.00
3/8"	470,000	235.00	2,820.00
1/4"	210,000	105.00	1,260.00
1/8"	52,500	26.25	315.00
1/16"	13,200	6.60	79.20
1/32"	3,400	1.70	20.40

(For steam at 50 pounds pressure, the waste is about 75% of the above figures; at 20 pounds, it is about 50%; and at 5 pounds, the loss is about 25%.)

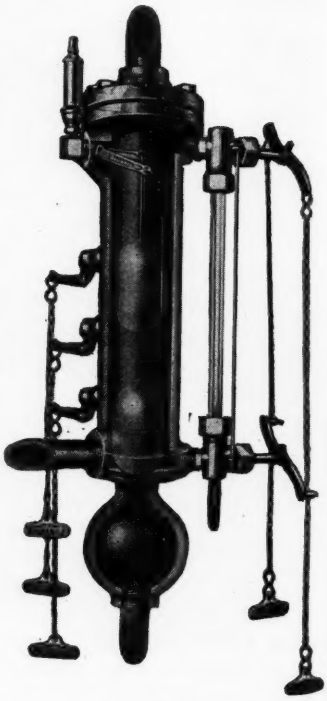
TABLE B
Temperature reduction caused by air at various pressures.

Gauge Pressure	Temperature of Steam with No Air Present	Temperature of Steam Mixed with Various Amounts of Air. (Per Cent Air by Volume)		
		10%	20%	30%
10.3	240.1	234.3	228.0	220.9
25.3	267.3	261.0	254.1	246.4
50.3	298.0	291.0	283.5	275.1
75.3	320.3	312.9	304.8	295.9
100.3	338.1	330.3	321.8	312.4

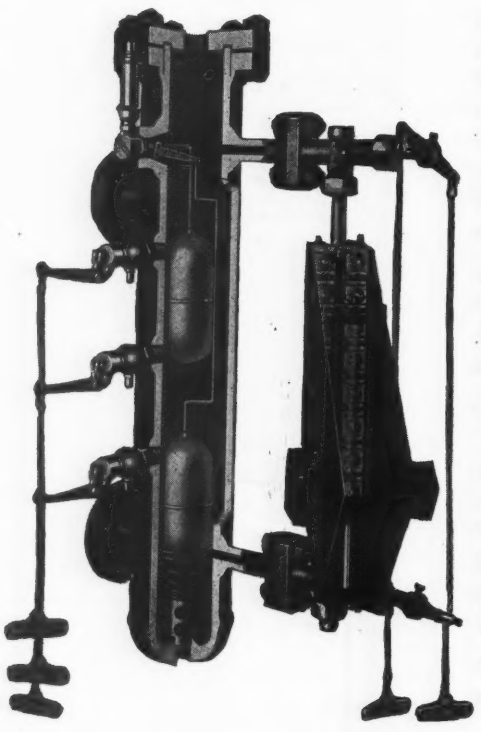
ARMSTRONG
Inverted Bucket
STEAM TRAPS

Keeping Step in the march of power development

Reliance Water Columns
fill any need you'll have for basic water level supervision



SOONER OR LATER you'll be studying plans for reconversion, expansion, modernization—whatever fits *your* situation in the industrial or power-producing field. When you come to prime power units—the boilers—you're likely to find you have a need for additional or different water columns—and other boiler water level safety devices.



• It will pay you to have basic data on Reliance Equipment at hand for consideration. For Reliance stands ready to supply any water column you need—and any gage equipment—for low or high pressures, for all types of service.

• Since 1884, Reliance has maintained leadership in Boiler Safety Device development and manufacture. Water Columns with Alarms, operated by the original *instantaneous* alarm mechanism, have helped to fortify power plants against consequences of boiler water failure for billions of operating hours.

• Selected as standard equipment by many boiler manufacturers and consulting engineers, Reliance Water Columns assure you the utmost of dependability—help protect your reputation for efficient low-cost power plant operation. . . . Write for catalogs, or get in touch with your nearest Reliance Representative.

THE RELIANCE GAUGE COLUMN COMPANY
5902 Carnegie Avenue . . . . . Cleveland 3, Ohio

60 Years of Boiler Protection

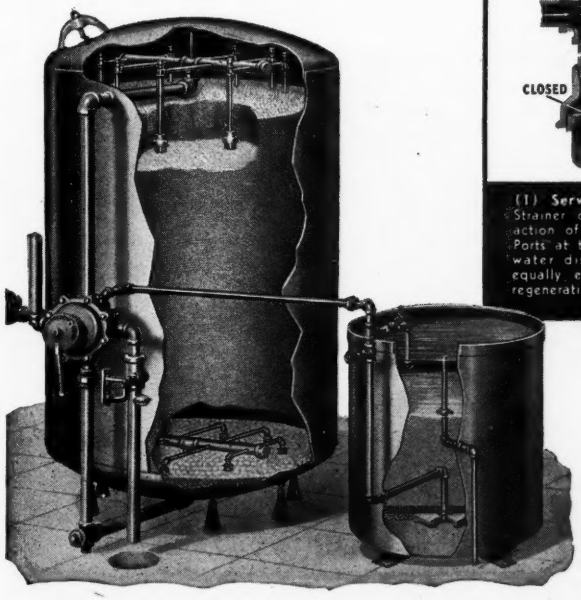
BOILER SAFETY DEVICES since 1884

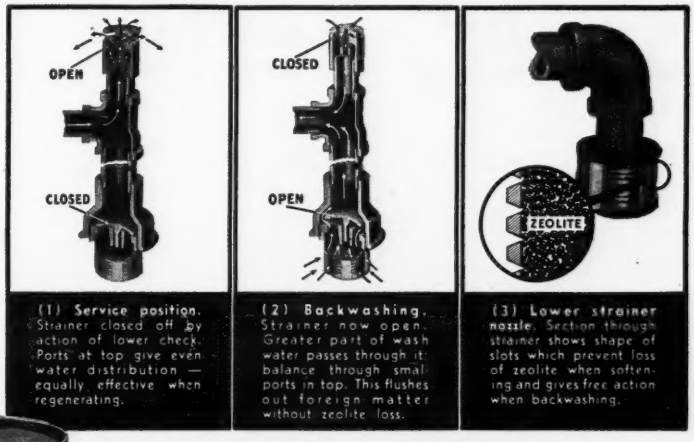
Reliance

44% MORE CAPACITY!

That's the remarkable record of the Improved Elgin "Double-Check" Water Softener

The improved "Double-Check" manifolds are shown in the cutaway view of the Elgin Softener below. Close-ups at right explain operation.





(1) **Service position.** Strainer closed off by action of lower check. Ports at top give even water distribution — equally effective when regenerating.

(2) **Backwashing.** Strainer now open. Greater part of wash water passes through it; balance through small ports in top. This flushes out foreign matter without zeolite loss.

(3) **Lower strainer nozzle.** Section through strainer shows shape of slots which prevent loss of zeolite when softening and gives free action when backwashing.

THE already well-established Elgin "Double Check" Water Softener has now been further improved to provide ever greater softening capacity and efficiency. Illustrated above is the improved "Double-Check" type manifold. It permits the use of a far deeper zeolite bed by preventing zeolite loss.

More zeolite naturally means more soft water output. The 44% increase in capacity headlined above is not the exceptional case, but is fully confirmed by a *long list of users* whose names are available to you.

Since the zeolite cannot escape, higher backwashing rates are possible with the "Double-Check" equipment. Better backwashing cleans the softener thoroughly and prevents packing and channelling. As a result, the brine reaches every grain of zeolite, giving better regeneration with less salt consumption.

If you are planning the installation of zeolite water softeners for power, process or general applications, don't overlook the added capacity and economy of this improved design.

ELGIN SOFTENER CORPORATION
136 North Grove Avenue, Elgin, Illinois

THE "DOUBLE-CHECK" ALONE—

- **Delivers up to 44% more soft water**
- **Prevents loss of zeolite**
- **Cuts salt consumption**
- **Permits more thorough backwashing**

("Double-Check" manifolds can be installed in any make softener)

STEP UP THE CAPACITY OF YOUR PRESENT WATER SOFTENER!

— the "Double-Check" manifold and Elgin high-capacity zeolite will do it.

The "Double-Check" manifold arrangement can be quickly installed in place of the ordinary manifold system of any make water softener to provide the above features. Immediate delivery can be made on any type zeolite required for refill purposes. Let us show you how economically these Elgin modernization steps can give you that much-needed extra capacity.

OTHER ELGIN PRODUCTS

- ▶ Boiler Water Conditioning Systems
- ▶ Deconcentrators
- ▶ Continuous Blowdown Systems
- ▶ Filters and Purifiers
- ▶ Oil Removal Filters
- ▶ Aerators
- ▶ Chemical Feeders
- ▶ Water Treating Chemicals
- ▶ Water Testing Equipment

Write for Bulletins

It "Grips like Magic" to Give you faster, safer, better Mounting!

Allis-Chalmers' new "Magic-Grip" is the *fastest mounting sheave on the market.* Three cap screws lock tapered split bushing, sheave and shaft securely . . . *in one operation.*

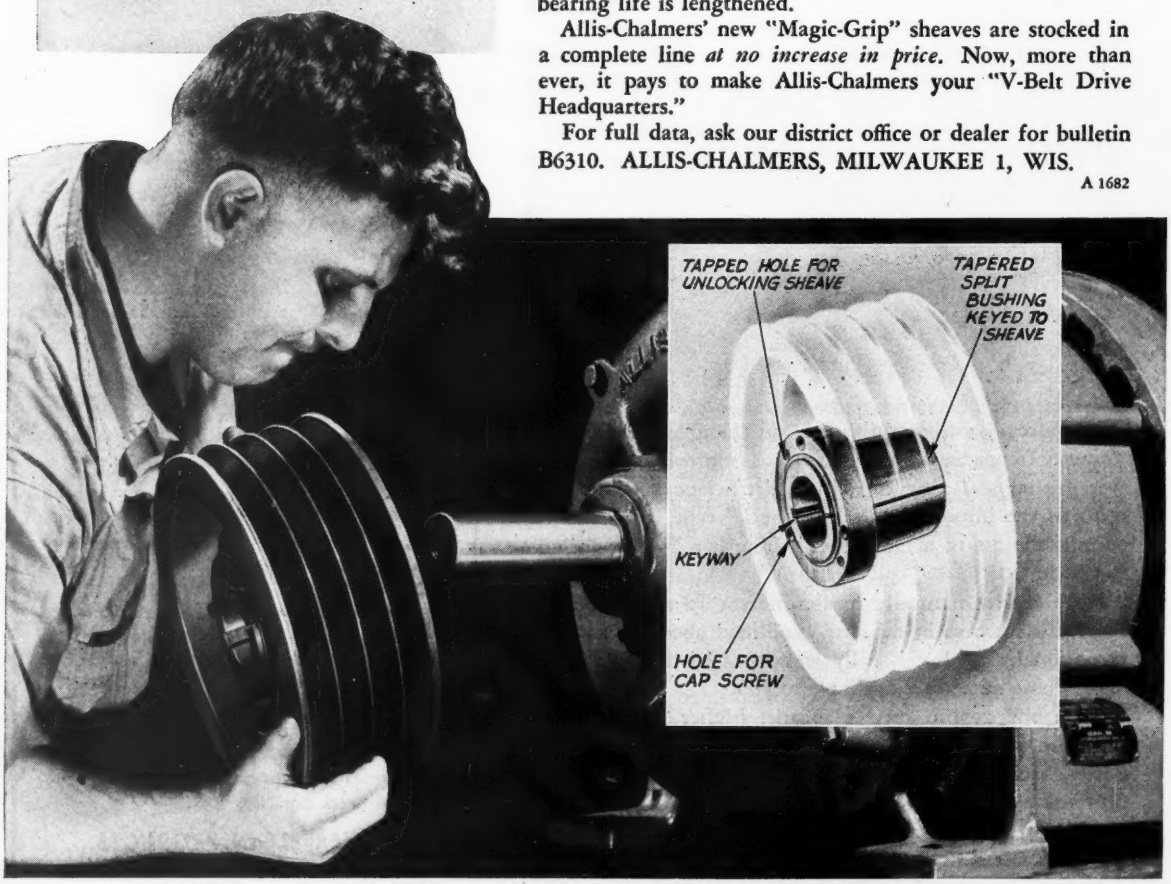
YOU get smoother running performance with "Magic-Grip" because . . . its positive clamp fit grips motor and machine shafts uniformly, eliminating back-lash and shear.

Vibration and stress resulting from shaft overhang are greatly reduced, too, since new design allows the sheave that "grips like magic" to be mounted closer to motor. Motor bearing life is lengthened.

Allis-Chalmers' new "Magic-Grip" sheaves are stocked in a complete line *at no increase in price.* Now, more than ever, it pays to make Allis-Chalmers your "V-Belt Drive Headquarters."

For full data, ask our district office or dealer for bulletin B6310. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1682



Allis-Chalmers Texrope

"MAGIC-GRIP" SHEAVES

MIDWEST WELDING FITTINGS

IMPROVE PIPING DESIGN • SAVE TIME • REDUCE COSTS

Qualified welders experienced on all kinds of piping report that Midwest Welding Fittings have exceptional dimensional accuracy and uniformity... saving time in layout because all pipe can be cut in advance according to drawings... saving time in lining up and welding... assuring more uniform welds.

Midwest originated and developed many of the fittings shown here: the "long tangent" elbows, saddles, sleeves, shaped nipples, and lap-joint stub ends with large radius and heavy forged lap. Midwest Saddles compensate for the weakening of header body resulting from the metal removed for neck opening; Midwest Sleeves relieve butt welds of any bending stress and much of tensile stress; Midwest Shaped Nipples eliminate all layout and templates when saddling one pipe upon another; etc. Get Bulletin WF-41 for complete information.

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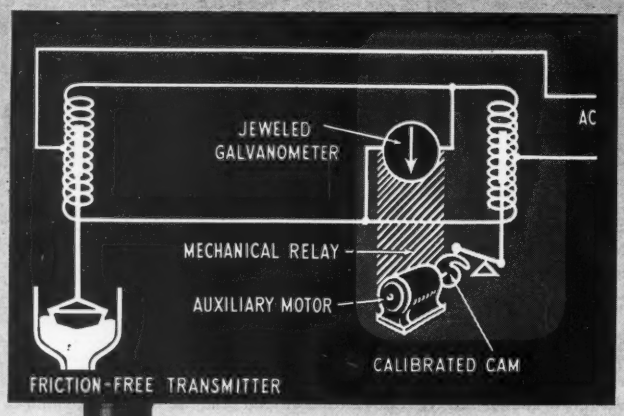
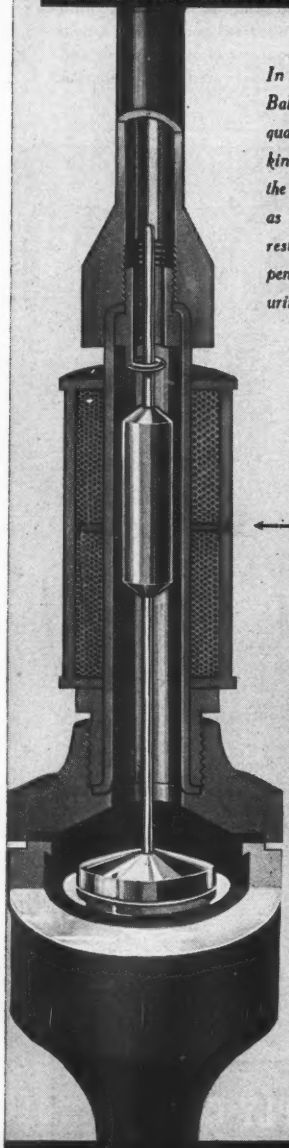


In the Cochrane Flow Meter, the Null or Zero Balance principle is employed, balancing the unknown quantity by adjusting a known quantity of the same kind. A highly sensitive detector is used to determine the point of balance. A friction-free transmitter serves as a pilot for an external motor drive. The motor restores the bridge to balance and operates recording pen, indicating pointer, and integrator. The measuring circuit is relieved of all work.



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This sensitive float acts as a pilot for the auxiliary motor drive, which operates with high and equal power throughout the entire scale.

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The capacity of a Cochrane Flow Meter may be altered to meet varying conditions in 15 minutes' time. Two styles of transmitter are available, one of which provides five changes of manometer tube, ranging from 18 inches water differential through 42, 75, 117 to 169. The other style transmitter provides for seven ranges, five as above plus two additional of 230 and 301 inches water differential.

Write for Publication 3010

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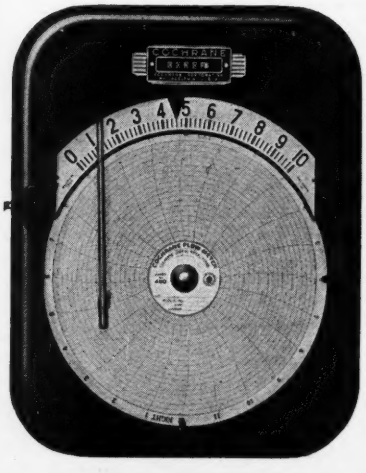

COCHRANE FLOW METERS

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TO ASSURE MAXIMUM HANDLING EFFICIENCY

The head end of an S-A Skip Hoist handling coal in a power plant. The skip bucket is in its top position, where it can be seen discharging coal into the large storage bin.

Wherever materials handling plays such an important part in the overall operation picture, it deserves special consideration by management, and a periodic review of existing methods.

Coal handling and ash removal are operations to which Stephens-Adamson has devoted special attention through its extensive work with power plants throughout the Nation.

These handling problems, of course, vary greatly from plant to plant. To meet the variety of requirements, S-A manufactures a *complete* line of correctly designed conveying and elevating equipment, including all related accessories.

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Where prolonged heavy duty operation threatens excessive wear there is a lubrication problem. Consult us about it.

(Write for "The Service Factor" — published periodically and devoted to the solution of lubricating problems.)

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JOHN CRANE Condenser Packing is quickly and easily installed. Just slip the Packing Rings into place with simple, inexpensive tools and seat with a few light hammer blows.

Ferrules are eliminated—thus no time is lost in reconditioning old ferrules or waiting months for new ones. And you get a *better job.* The packing is tight from the start—no adjustments are necessary—and there's no danger of cracking the tubes.

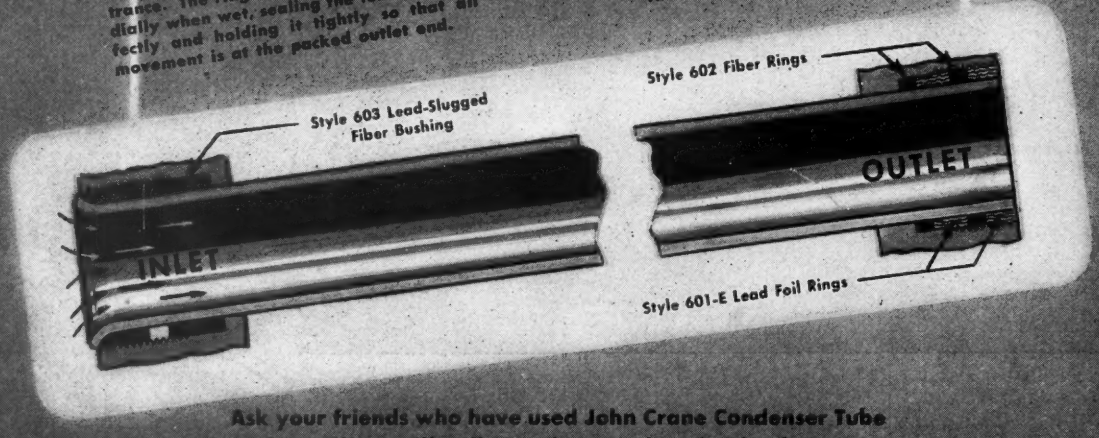
To shorten down-time and save valuable man-hours, use the John Crane Packing Method—the easiest, quickest, most economical method of all.

Inlet End

The Inlet End of the tube may already be rolled into the tube sheet. If not, the same effect is obtained by using a Style 603 Lead-Slugged Fiber Bushing driven into the stuffing box as shown below, with the tube end belled to make a "Venturi" entrance. The ring fits closely and swells radially when wet, sealing the tube end perfectly and holding it tightly so that all movement is at the packed outlet end.

Outlet End

The Outlet End of the tube is packed with a set of metallic and fiber rings as shown below. The soft lead foil rings flow into and fill the threads, while the fiber rings fit closely and swell radially when wet. The tube is free to expand and contract at the outlet end, yet a tight seal is maintained.



Ask your friends who have used John Crane Condenser Tube Packing—they will tell you it costs less in the long run, is easier to install and improves over-all condenser efficiency. Then write for our Engineering Recommendations.

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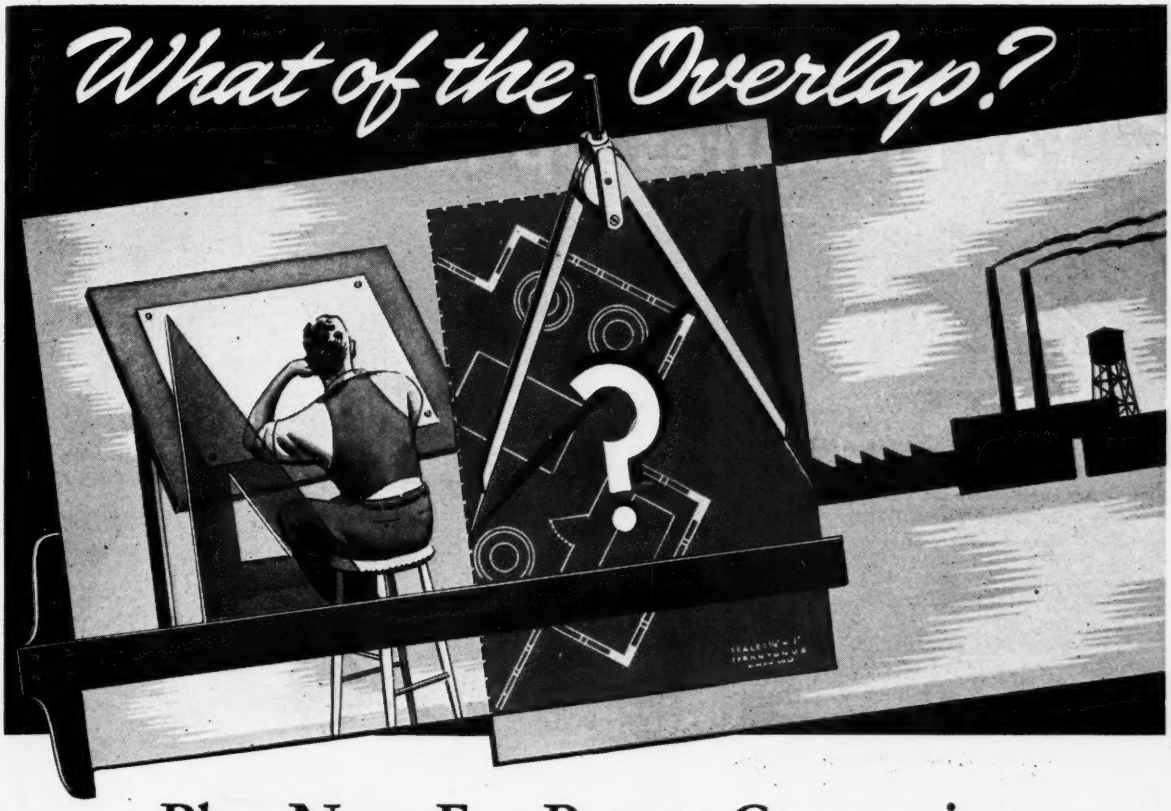

Plan Now For Power Conversion

American industry faces a tremendous task. The economic stability of the entire nation will depend upon industry's ability to convert from wartime operation to peacetime production with a minimum of time loss. Power is all-important in keeping the wheels of industry turning uninterrupted during that overlapping period of reconversion.

Power planning now is essential. Tomorrow's successful reconversion will depend upon the thoroughness of today's plans. Such planning requires competent, proven engineering. Theory must be combined with practice. To that end, J. F. Pritchard and Company Power Engineers are equipped and ready to assist with your particular problem. From the fundamental prime mover through the ultimate power use, Pritchard Power Engineers can design, engineer and construct your power plant. J. F. PRITCHARD & COMPANY, Power Division, Fidelity Building, Kansas City, Missouri.

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Yarway Impulse Traps

For Pressures Up to 1500 lbs

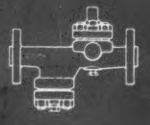


Fig. No. 140 to 147. Medium pressure integral-strainer Impulse Trap for pressures up to 600 lb. Steel body, flanged connections.

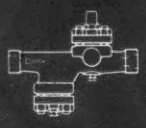


Fig. No. 250 to 257. Medium pressure integral-strainer Impulse Trap for pressures up to 600 lb. Steel body, socket weld connections.

Fig. No. 410 to 417. Low pressure integral-strainer Impulse Trap for pressures up to 150 lb. Bronze body, screwed connections.

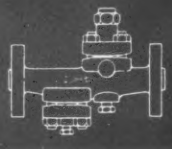
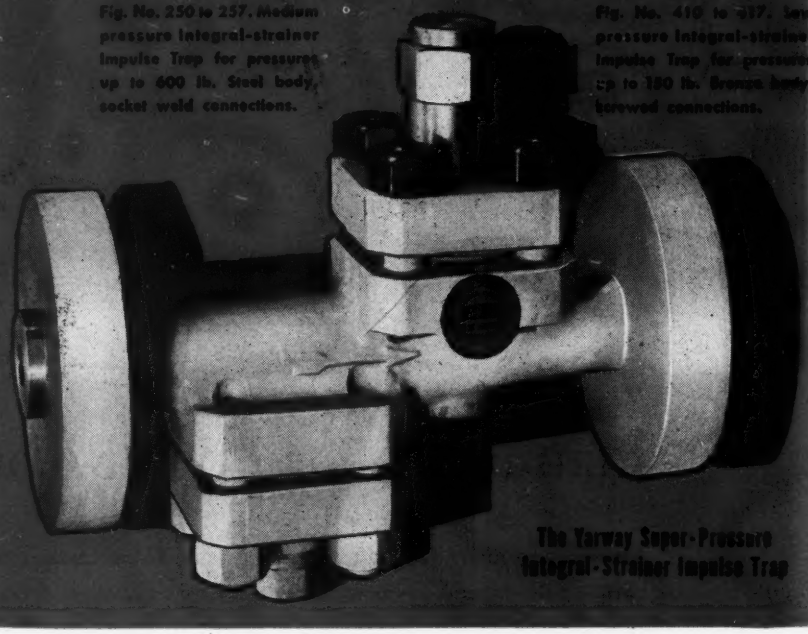
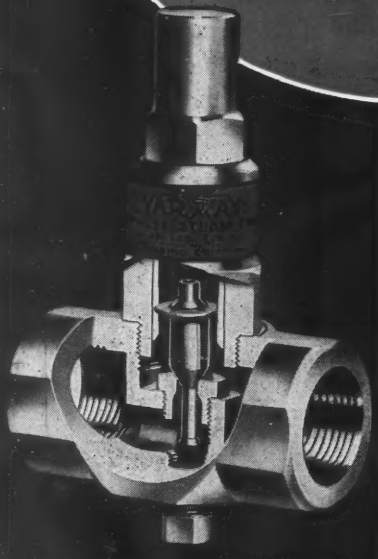


Fig. No. 150 to 157. Super-pressure integral-strainer Impulse Trap for pressures up to 1500 lb. Steel body, flanged connections.



The Yarway Super-Pressure Integral-Strainer Impulse Trap



The Standard Yarway Impulse Trap. Note only one moving part — a little valve.

ALONG with the remarkable success of the YARWAY IMPULSE TRAP for standard trapping service (more than 300,000 have been purchased), has come its use in steam plants where pressures as high as 1500 lbs and temperatures as great as 900°F are encountered.

The integral-strainer trap shown above, developed for this service is suitable for every drainage requirement in high pressure steam installations. It has ample condensate capacity when system is being "warmed up". It will handle relatively small amounts of high temperature condensate, efficiently, without losing its prime.

The valve closes positively in the presence of dry or superheated steam.

It is a fraction of the size and weight of other type traps designed for the same service—saving space, simplifying installation and requiring no support.

It is suitable for all pressures within a wide range without change of valve or seat.

It has the same simplicity of design as does the standard Impulse Trap—only one moving part, a little valve.

Its integral-strainer protects the trap against scale and rust in the system.

For complete description of operating principle, send for Bulletin T-1738.

YARNALL-WARING COMPANY, 114 MERMAID AVE., PHILADELPHIA 18, PA.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Standardization of Electric Apparatus

By H. V. ERBEN

STANDARDIZATION of heavy electric apparatus means the channeling or directing of purchases into a relatively small number of types and ratings, selected so that they will meet the requirements of the vast majority of applications. By concentrating engineering and manufacturing talent on fundamental improvements in these standard ratings, it will be possible for the electrical manufacturers to achieve a degree of perfection in design and in manufacturing methods which is unattainable with special "one-of-a-kind" designs, except at prohibitive cost.

Why is standardization of particular importance to the utilities *now?*

It seems certain that the utilities will continue to be burdened with high tax loads and high labor costs after the war. In the face of continuing pressure for *lower* rates, there is certainly no assurance that the resultant increase in operating costs can be compensated for by *higher* rates. Unless utility profits are to suffer, means must be found to reduce *other* items of cost. Standardization of electric apparatus may offer at least a partial solution, because experience shows that, in general:

First: The installed cost of standard apparatus is lower than that of special or piece-meal designs. This results directly in a reduction in capital charges.

Second: The simplicity in specifying, ordering and co-ordinating purchases of standard apparatus, as well as the flexibility of its application result in savings in operating cost which, although difficult to estimate to the last dollar, are tangible and very considerable.

In our wartime experience, and in that of other manufacturers, it has been demonstrated that cost savings of a surprising magnitude, together with very tight quality control, are possible through standardization and repetitive manufacture.

Since the discussion of apparatus standardization at the EEI Annual Meeting last June, perhaps more interest has been shown in standardization of large land turbine generators than in any other type of equipment. This is probably due in part to the disclosures regarding wartime experience in turbine production and also due to the fact that turbine generators are large, costly, and spectacular. Yet, in my opinion, the large utility turbine is probably not the most likely field for standardization. Other lines of apparatus would seem to show more promise of immediate results.

This is so because even under the most optimistic estimates of postwar business in large turbine-generator sets, the number of units which a manufacturer may be called upon to build is quite small. However, an ASME Committee is working on the establishment of preferred sizes, temperatures and pressure for turbines. Similar activity by AIEE is under way on generators, and it is likely that specifications for new machines will tend to cluster around these preferred ratings.

Repetitive manufacture of mechanical drive turbines has already reduced the price an average of 10 per cent and produced a better product, which can be built and shipped in a shorter time.

I believe that the power transformer offers the utilities and the manufacturers a most fruitful field for co-operative standardization.

Unit substations offer an interesting example of the application of standardization to a "package" article. Here, by careful study of the field requirements, it was found possible to develop a relatively few standard components which can be assembled into a great variety of combinations. Despite this great number of arrangements, the line is now covered by 18 standardized tanks, 18 cores, 2 junction boxes, 3 switches, and 2 metal-enclosed interconnections to switchgear.

Probably more attention has been directed to standardization in switchgear than to any other heavy apparatus line. This standardization, and the repetitive manufacture which it made possible, has resulted in price levels for outdoor circuit breakers about 15 per cent below those of 1937 or 1938. This has been accomplished in spite of large increases in material cost and wage rates during this period, and in spite of the extra cost of major improvements and refinements in the product.

Progress has also been made in the standardization of indoor station type breakers for 15 and 23 kv service, 500,000 through 2,500,000 kva interrupting capacity. The number of ratings in this field has been reduced from about 760 in 1928 to 18 today.

The development of modern vertical-lift metal-clad equipment for medium voltage service also began around 1928. The number of breakers required to cover this field has been reduced from 360 to 32 (a 90 per cent reduction), and it is hoped that ultimately only 16 breaker ratings will suffice.

Today, instead of thousands of special housings or mountings, we have just *three* frames sizes of metal-clad units which cover the entire medium voltage range, housing breakers from 25,000 through 500,000 kva interrupting capacity.

Lower equipment price is by no means the *only* advantage to be obtained from standardization. The manufacturer of standard apparatus can generally produce the complete equipment or component parts in anticipation of receipt of orders. Shorter shipment is, therefore, possible, delays due to failure in production are reduced, and a more uniform factory load is obtained. Also the purchaser finds that complete information on the product is more readily available, and the preparation of specifications and placing of orders is simplified. Dimensions and outlines can be obtained quickly and installation time and money are usually saved through purchase of package equipment. If the power system is designed around standard equipment, greater flexibility is obtained as more and more standards are installed. Standard apparatus can be moved from one location to another as load requirements shift or grow. Fewer renewal and replacement stocks are needed because the same parts are applicable to many equipments. Many of the more popular ratings of standard apparatus will be available from manufacturers' stock, reducing the inventory requirements of individual purchasers.

Another advantage which the utility gains from use of standard apparatus is that utility engineers are relieved of the burden of detailed equipment design and the study of manufacturers' catalogs covering hundreds of "nut and bolt" items. Thus, their time and effort can be devoted directly to the study of the basic problems of power system design.

In this connection there is a growing tendency toward diversity of location and flexibility in arrangement in power system design. This trend favors lower power system cost, because it leads to increased simplicity of system design and results in the use of more and smaller units which can be produced in quantities.

H. V. Erben, is manager of the Central Station Divisions of the General Electric Co. A native of Schenectady, he is a graduate of Yale's Sheffield Scientific School as a mechanical engineer. First employed by G. E. in 1917, he left for U. S. Army service as a second lieutenant, field artillery, re-entered the company's employ in 1920. He was on "Test", served in the lighting engineering division, in 1923 was named a section head in the apparatus division of the reorganized Central Station department, becoming assistant to the manager in 1928 and manager in 1929. In 1933, he was promoted to manager of the switchgear sales division with headquarters in Philadelphia. He was made an assistant manager of the Central Station department in 1939, and manager in 1941. The above comments are from his recent paper before the Public Utility Buyers Group, National Association of Purchasing Agents.

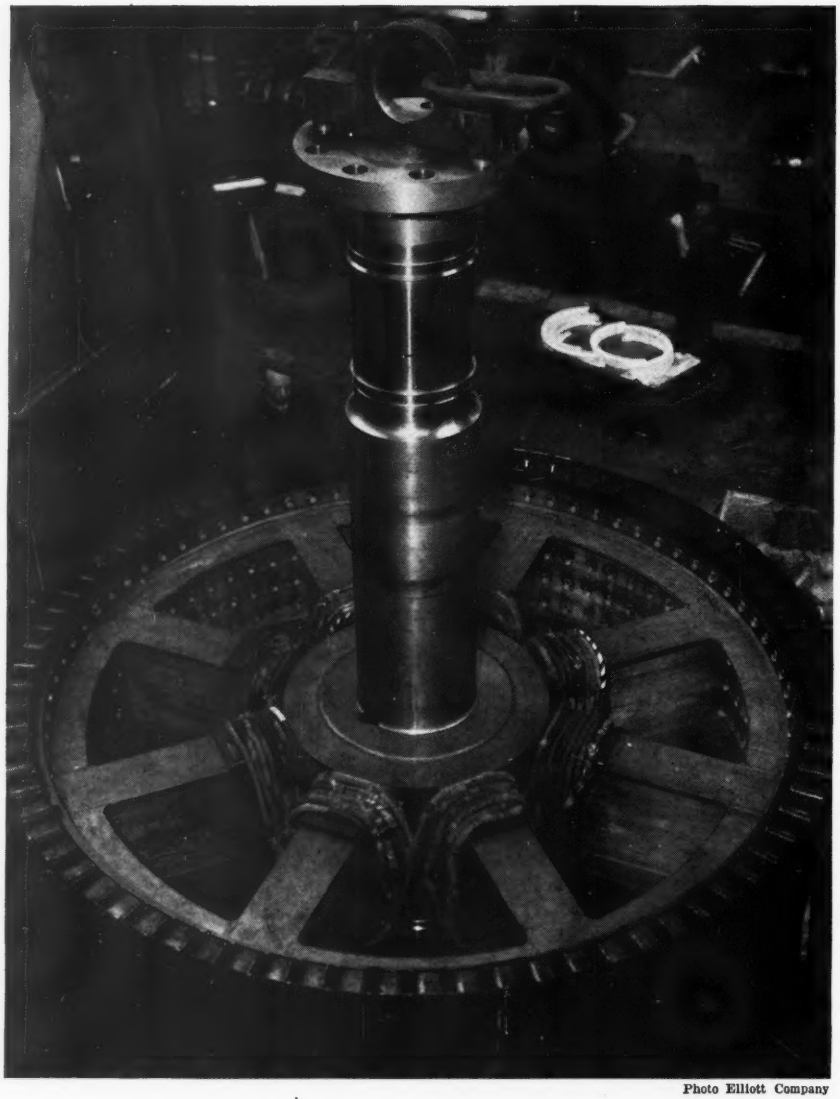


Photo Elliott Company

Large Scale Induction Heating

THIS PICTURE shows an interesting application of induction heating on a large scale in the manufacture of a low-speed synchronous motor. It was used in effecting a shrink fit between the shaft and the spider of the motor. This method of fitting a shaft has been used for many years in connection with flywheels but in such cases the heat was usually derived from a furnace built around the hub of the wheel or rotor. In this case the job was done very simply by means of induction heating. As shown, ten turns of heavy, all-asbestos covered cable were wound loosely around each spoke of the spider. One continuous conductor was used with the turns alternating from clockwise to counter-clockwise on adjacent spokes. The voltage used was 220, single phase, 60 cycles and the current was 300 amp. The current was applied for 5 hr, during which time the 23 ton rotor was heated to 155 F. The shaft weighed eight tons and was turned from a one piece forging. During the heating operation, the spider was completely covered with a canvas tent. By this method the hole in the spider hub was expanded approximately 0.022 in., sufficient to permit the easy insertion of the shaft. This machine is one of a number being built by the Ridgway plant of Elliott Co. for the Maritime Commission. The motors are designed for operation at 4000 v, and they develop 6600 shaft hp when operating at 93 rpm.

WITH THE EDITORS

◆ **Symbols**—Just as this issue is about to go to press, an announcement from the American Standards Association brings the glad tidings that an agreement has been reached for the duration of the war at least in regard to the standardization of electrical symbols. According to this announcement, the graphical symbols for electrical and electronic equipment have been unified into a consistent set of symbols that will mean the same thing to everyone who uses them—even to the "power" people. Heaven be praised, or maybe the ASA!

It has taken a long time and much needless argument. The need for such a coordinated system of indicating electrical circuits and engineering equipment on engineering drawings is obvious, and has long been recognized. Every commercial and Armed Force drafting room that does any electrical work at all uses these symbols. Previously one symbol was sometimes used to indicate two different pieces of apparatus, and in some cases two different pieces of apparatus meant the same thing. On communication equipment drawings, for example, two short parallel lines was the standard symbol for a fixed capacitor. On drawings for power equipment, however, two such parallel lines denoted a contactor. Similar confusion existed in the representation of resistors and electromagnets.

◆ **Came The War**—Offhand, the standardization of these symbols might seem a simple thing but nobody who has not followed the discussions on this subject has any idea of how difficult it was. The question has been under discussion for several years. Even now, the new war standard is a compromise but it represents a workable solution of a problem that has long been irritating to engineers. The original conflict in the use of symbols came about because the Power Industry which generates and distributes electrical energy, and the Communications Industry which transmits intelligence, each developed its own set of symbols. This caused little difficulty as long as there was little intercourse between the two branches of the electrical field. When the war came, the trouble began. The wide expansion of the use of electronic devices during the war in communication, control and detecting devices resulted in much overlapping of the two fields and it became necessary to use common sets of drawings for design, manufacturing and maintenance purposes. The Armed Forces, faced with the task of training large numbers of new men, found the lack of uniformity on drawings a constant source of trouble.

◆ **Argument**—The needs of war, thus brought renewed pressure to bear on this question of symbol standardization and many meetings and discussions were held, mostly without very much effect. A large meeting was held in New York on January 22 of this year under the aegis of the ASA to which representatives of technical societies, trade associations, the War and Navy Departments, the Aeronautical Board, the National Aircraft Standards Committee and certain other organizations were invited. It was at this meeting that the compromise set of symbols contained in the new War Standard was put forth. At the time these seemed satisfactory to everybody concerned and the representatives of the Armed Forces *prayed fervently*, as Electronics put it in a recent editorial for a quick decision.

This prayed-for, quick decision, however, was extremely slow in forthcoming. Letter ballots were sent out with the request that they be returned by February 15 but they were not and after several weeks of waiting it developed that certain "power" people did not feel that the compromise symbols were satisfactory. So another meeting was held on March 10 where new compromises were set up, and later new letter ballots were sent out.

These have now finally, if somewhat reluctantly, been approved and as the result the new War Standard has been issued. The point to be emphasized here, however, is that this whole question could have been settled months, even years ago, if there had been greater willingness on the part of those concerned to cooperate. But as in all instances of this kind, each group is determined to hold on to what it has. This was particularly true of the power people in this case—they were the ones who were most reluctant to relinquish any of their symbols. As a consequence months were wasted, slowing up the war effort and irritating the Army and Navy no end. Though the agreement was forthcoming in the end, it came almost too late.

In a world at war, looking forward to a peace founded upon better understanding and greater international cooperation, this sad display of the cooperative abilities of one small group of scientifically minded people is not very encouraging. If it takes so much time and so much argument and effort to settle a simple little question of a few symbols among a group of men of similar temperament, what can we expect in regard to the settlement of the tremendously complex problems involved in the world situation today?

◆ **The Power Engineers of 1950**—A very progressive young engineer we know, responsible not only for power generation and utilization but also for a wide variety of production problems in his industry, plans to establish an incentive program for the operators in all his company's power plants as soon as it can be put into effect. His plan is designed to avoid the fallacies in so many of the bonus plans based on CO_2 and things of that kind, which have been tried without too much success. We hope to give you further details of this later.

One of the factors influencing this engineer's thinking is the problem of the future of young men in power plant work. This engineer points out that a great many of the men now operating our power plants are either so old or so completely unable to develop the necessary initiative to improve their technical skill and understanding, that they will not be the men who are operating our power plants five years from now. Those power engineers of 1950, he says, are now in the armed services. There they are operating a great deal of the very best and most recently-built power equipment that we have, both in marine service and in stationary service in this country. That's where a great deal of it has gone during the war.

Here is this array of alert young men, becoming accustomed to the sort of equipment that has been developed over the last ten years into very dependable and efficient units, based on proved principles. They are going to come out of the service some day looking for power plant jobs. Are they then going to be interested in going into some plant that is almost literally a pile of junk, full of equipment that should have been scrapped back in the 20's, with no assurance from the management that anything will be done to bring it up to date, with no assurance that there will be a financial reward for their work, commensurate with its importance either to industry or to society, or comparable in any way to what can be earned with much less effort in some other line of work?

There will be a certain number interested in the work for its own sake, but they will not go into it, upon discharge from Army or Navy, unless they see a good professional future in it. Furthermore, our engineer friend points out, the supply of men from the engineering colleges available for power engineering jobs has been seriously depleted and it will take time to replenish it.

Here is a situation management will have to meet that has absolutely nothing to do with labor unions. However, we don't expect to see them do anything about it until the situtation actually arises, for it is not the American way of doing things to cross bridges before we come to them. Then when we find the bridge isn't there, we have to stop and build it. Usually it turns out to be a pretty good bridge, although it may be too late to use it.

◆ **Are power engineers professional men?**—If so, what is the distinctive mark of a professional man? One answer to this question is given in the famous address, The Second Mile, by William E. Wickenden, President, Case School of Applied Science, delivered before the Engineering Institute of Canada.

Says Dr. Wickenden: "First, we may say that it is a type of activity which carries high individual responsibility and which applies special skill to problems on a distinctly intellectual plane. Second, we may say that it is a motive of service, associated with limited rewards as distinct from profit. Third, is the motive of self-expression, which implies joy and pride in one's work and a self-imposed standard of excellence. And fourth, is a conscious recognition of social duty to be fulfilled, among other means by guarding the ideals and standards of one's profession, by advancing it in public understanding and esteem, by sharing advances in technical knowledge, and by rendering gratuitous public service, in addition to that for ordinary compensation, as a return to society for special advantages of education and status." It seems to us, that the engineer must not only be a professional man but that he must convince society that he is one. In the past 50 years, he has failed to do so.

New 100,000-lb-per-hr Boiler S

New unit is first part of modernization program at Tractor Works power plant of J. I. Case Co., Racine, Wis. . . . Average boiler efficiency 85.5%; test efficiency 88.5% with Illinois coal . . . Now burning 25% coal 75% coke breeze mixture . . . Attention to minor design and operating details contributes to high performance . . . Shows what can be done with modern standard equipment . . . Details of boiler design and auxiliaries . . . Flue gas temperature below 250 F, no air preheater corrosion . . . Accessibility and ease of operation are features . . . No operating troubles . . . Charts show performance of unit . . . Helps war plant increase production, cut cost of war materials . . . Fuel savings alone pay for unit in 3½ years.

By C. H. Morrow *Assistant to Vice-President, J. I. Case Co., Racine, Wis.*

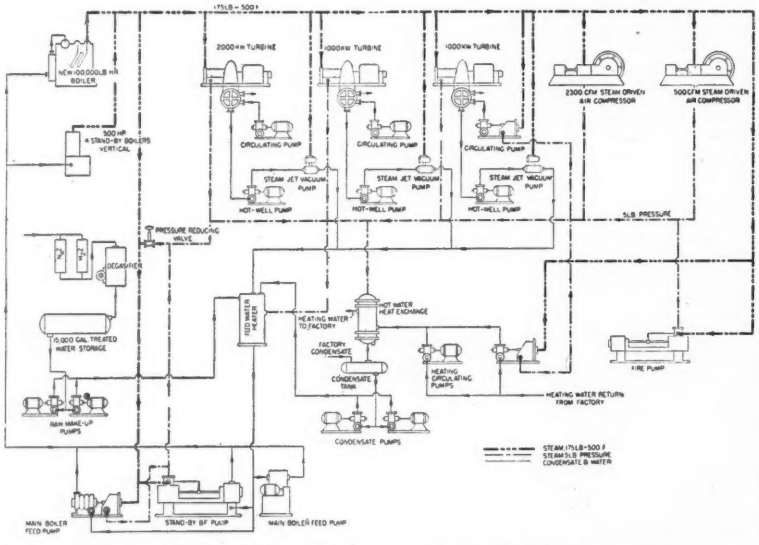


Fig. 1. Schematic diagram of Tractor Works power plant as it exists at present after carrying out first step of modernization by installation of new 100,000-lb-per-hr boiler, feed pump and water treating plant. Manufacturing plant heated by a hot water system

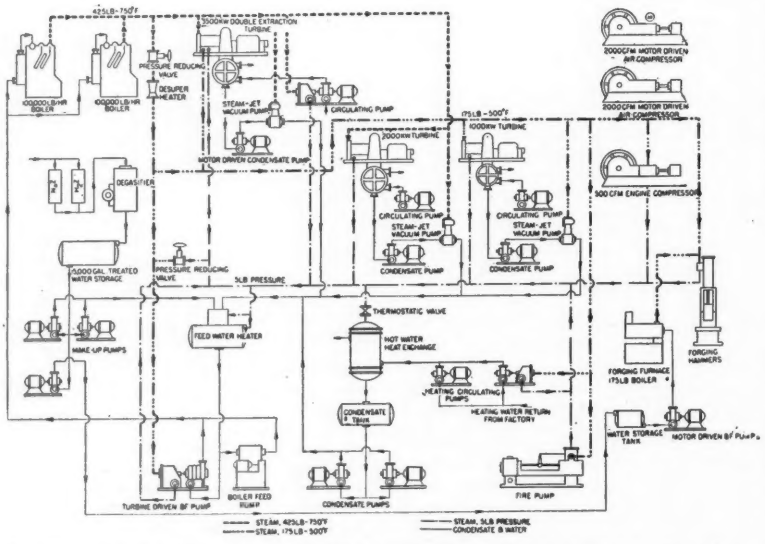


Fig. 2. Schematic diagram of Tractor Works power plant as it is planned for the future. New forge shop steam hammers taking steam supply from new double extraction induction turbine will exhaust back to it. Note proposed forge shop waste heat boilers

A NEW 100,000-lb-per hr boiler unit completed in June, 1943 at the Tractor Works of the J. I. Case Co. in Racine, Wis., is saving approximately $100 per day in fuel costs while at the same time meeting increased power service demands brought about by the war production program of the company. This unit is part of a rather comprehensive power plant improvement and rehabilitation program originally developed prior to the entry of this country into the war. The boiler unit has operated at an average efficiency of approximately 85.5 per cent since installation and under test has developed an efficiency of 88.5 per cent with Illinois coals and 89 per cent when using West Virginia coal.

While the installation of this boiler unit is part of a program started before the war, it has been necessary to hold in abeyance the major part of the work contemplated, due to lack of priorities for the necessary equipment. The outstanding feature of the entire modernization program is the attention given to reliability, accessibility, ease of operation and high efficiency in all of the designs. This is illustrated in the portion of the program already completed.

General Modernization Program

At the time the modernization survey was started, the plant consisted essentially of four 500-hp vertical water-tube boilers fired with V-type natural draft stokers and operating at 175 psi and 425 F steam temperature; three turbines, one 2000-kw and two 1000-kw machines with the condenser having been removed from one of the 1000-kw turbines, reducing its capacity to approximately 400 kw; one 2300-cfm

Saves $100 a Day in Fuel

steam-driven air compressor; and one 500-cfm air compressor; and the necessary auxiliaries, pumps, heaters, etc.

Figure 1 shows the schematic arrangement of the plant as it now exists with the new boiler installed, along with an additional boiler feed pump and the new water treating plant. Also, a condenser has been installed on the turbine that formerly was operated non-condensing, and the condensate handling system has been revised and improved to fit into the final power plant hookup.

The final future plant hookup is shown schematically in Fig. 2. Principal features of this are: the new 100,000-lb-per-hr boilers operating at 425 psi, 750 F temperature steam conditions at the throttle of the turbine; the installation of a new 3500-kw double extraction condensing turbine with provision for induction at the low pressure extraction point; the installation of a forge shop supplied with extracted steam from the turbine and exhausting back into the same turbine at the low pressure induction point; the rebuilding of the existing 2000-kw turbine to operate at the higher steam pressure and steam temperature; and replacement of the 2300-cfm steam air compressor with two electric-driven machines.

This program has been worked out very carefully in detail and will ultimately be completed. It is anticipated that it will make the Tractor Works plant of the J. I. Case Co. one of the most economical industrial plants for its size in the United States.

General Description of Boiler Unit

The new boiler unit, as shown in Fig. 3, is a four-drum bent-tube type, equipped with a pendant type superheater, extended surface economizer, tubular air heater, forced and induced draft fans, water walls, suspended refractory setting, and fired with a continuous-cleaning spreader type stoker. It has a continuous capacity of 100,000 lb of steam per hour when burning Illinois coals.

The boiler was installed in an existing open bay in the boiler room without any building alterations other than openings in the roof to permit the passage of the gas duct to the induced draft fan and the stub stack which rests on the induced draft fan.

Because the present boiler room building was designed for the installation of vertical water tube boilers, it was necessary to design the new boiler unit to be very short in depth and very high. There was no building problem so far as width of the unit was concerned. The layout, Fig. 3, shows that all the available space in the boiler room has been used in the installation. Although the unit is extremely compact, it is completely accessible and easily maintained.

Boiler Design Details— 1. Water Walls

The furnace is equipped with water walls spaced [illegible]-in. centers on both the side w[illegible] and the rear wall. These tube[illegible] are 3¼-in. in diameter and extend from a header located at the grate line of the stoker to another header 14 ft from the floor line. The upper side wall headers are connected to the front upper drum with tubes also 3¼ in. in diameter and spaced on 18-in. centers at the header.

The bridge wall water walls are formed by extending the front row of boiler tubes down along the rear wall into a rigidly anchored header at the rear of the stoker, as shown in Fig. 4.

Water wall surfaces have a very high heat absorption rate, therefore it is desirable to have as rapid cir-

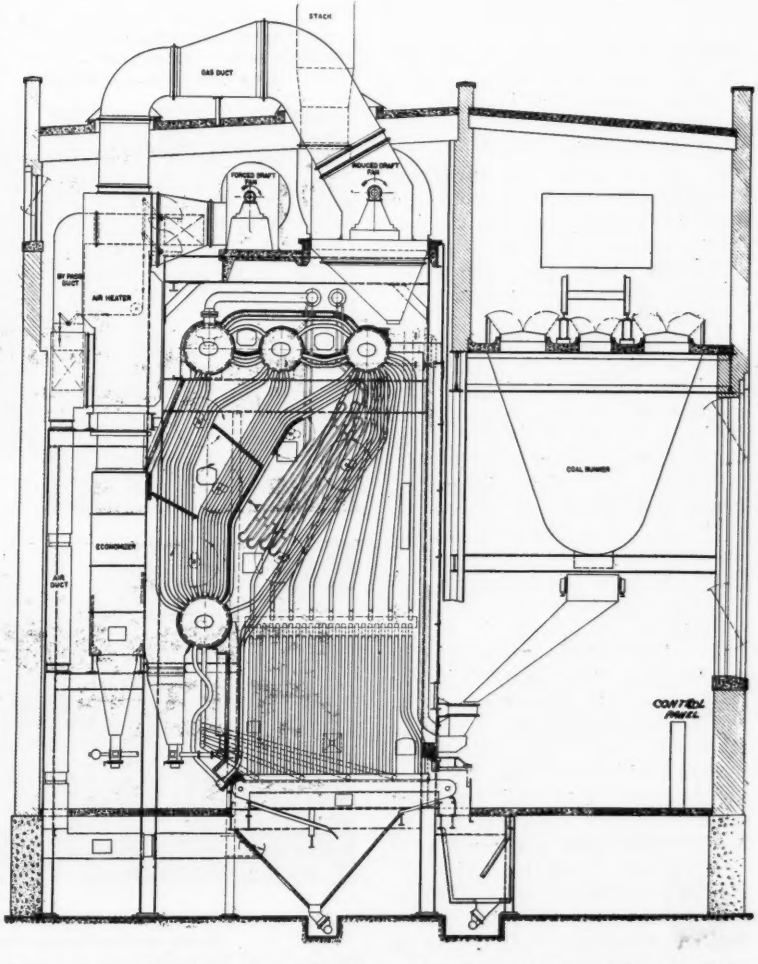


Fig. 3. Cross-section through new 100,000-lb-per-hr boiler unit and assembly of auxiliaries. Plant is near a hillside, hence coal cars can be run in on a horizontal trestle to unload direct to bunkers

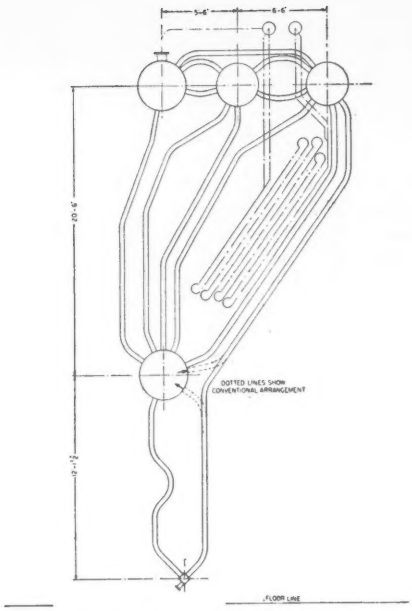
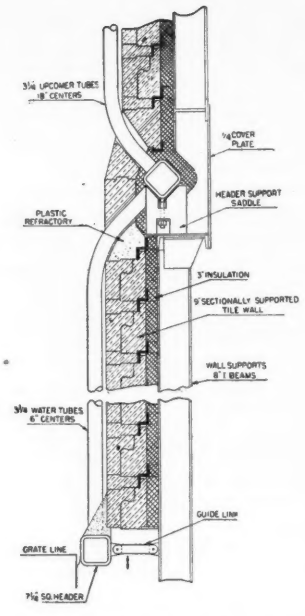


Fig. 4. Detail of boiler tubes showing method of connecting front tubes to insure good circulation



DETAIL OF SIDE WATER WALL CONSTRUCTION SHOWING UPPER HEADER RIGIDLY SUPPORTED BY REFRACTORY STEELWORK AND FLOATING LOWER HEADER

Fig. 5. Details of support for water wall headers, showing upper header rigidly fastened to refractory supporting steel, lower header floating

culation in these tubes as possible for best heat transfer and to prevent over-heating of the tubes.

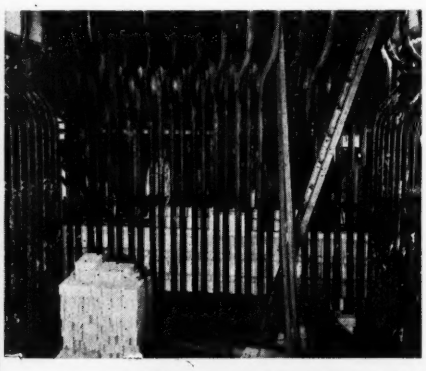
With the conventional arrangement shown in the dotted lines on Fig. 4, the head that produces circulation in the tube would be approximately 12 ft times the difference in density of the water in the lower drum and the rising mixture of steam and water in the water wall tube. If the water wall tubes are extended up to the front drum as shown by the solid lines, the head tending to produce circulation is then approximately 32 ft times the difference in density between the downward circulating water and the mixture of steam and water and the water wall tube. With the arrangement we have used, there is almost three times the head for producing circulation as in the conventional arrangement.

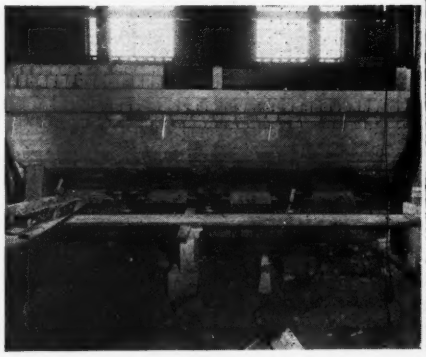
Another disadvantage of the conventional arrangement is the interference to circulation when the bridge wall tubes discharge into the lower drum near the first row of boiler tubes. Both the bridge wall tubes and first row boiler tubes are absorbing heat at a very rapid rate and must have unrestricted circulation. The discharge from the bridge wall tubes sets up an objectionable interference with the water trying to enter the first row of boiler tubes. In some instances, this condition has contributed to the failure of the front rows of boiler tubes. Another advantage of the continuous water-wall tube is the protection it offers to the lower drum from radiant heat in the furnace.

Water-Wall Header Suspension

The upper side water-wall headers are mounted in a very unusual manner. It is customary to mount this header on springs so that its movement is unimpaired and, in most instances, some expansion is taken care of by movement of this header. Figure 5 illustrates the manner in which the upper water-wall header in this boiler is rigidly fastened to the steel work which supports the refractory walls. Figure 6 is a view of it during construction. The lower header at the grate line is allowed to float up and down, its movement guided by a link between the header and steel columns.

The purpose of this design is to prevent differences in movement of the upper water-wall header and the refractory furnace walls. This construction detail has been very satisfactory to date, and no difficulty of any sort has been encoun-





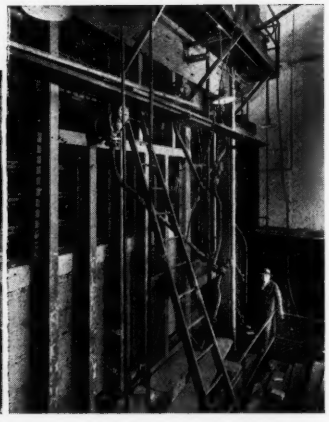


Fig. 6. Upper left—Upper water wall header during construction, all water wall tubes installed, sectionally-supported refractory wall being laid up
Fig. 7. Upper Right—Front row of boiler tubes extended to form bridgewall water screen, also showing tubes bent to provide maximum heat transfer to superheater
Fig. 8. Lower Left—Looking toward front of furnace, stoker feeder openings and arch
Fig. 9. Lower Right—External view, showing soot blowers and sectionally-supported wall

tered, nor have any air leaks in the setting developed at this point.

All the circulating supply tubes leading from the lower drum to the lower water-wall headers are 4 in. in diameter. One supply tube is installed for each six water wall tubes. The lower rear water-wall header is rigidly fastened to the rear steelwork of the stoker so as to maintain a positive relationship between the rear water wall tubes and the rear tuyeres of the stoker. Because of this rigid fastening, it was necessary to bend the 4-in. supply tube shown in Fig. 3 to take care of any movement of the lower drum without interfering with the header.

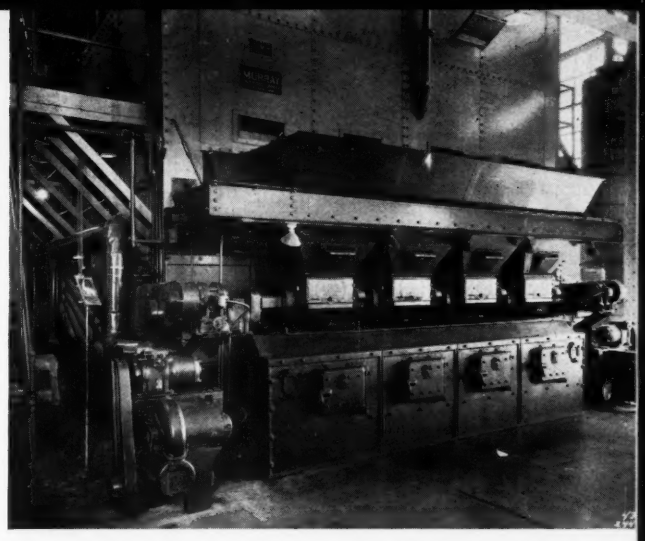


Fig. 10. View of stoker and boiler front during operation, showing feeder and moving grate drives for each two sections of feeders and grates, permitting each half of stoker to be operated independent of other half

2. Boiler Setting

The entire setting of the boiler unit is sectionally supported and insulated with a total of 3 in. of insulation. The portion of the furnace subject to high temperatures, as well as the first and second passes of the boiler, consists of 9-in. tile supported on meehanite castings every 14 in. The front wall of the furnace is also 9 in. and sectionally supported; however, it is air cooled. That portion of the setting to the rear of a line extending up approximately at the bridge wall is 4-in. sectionally-supported tile and also insulated. The economizer forms the rear wall of the boiler; however, the portion of the rear wall not formed by the economizer is also sectionally-supported 4-in. tile. No refractory repair work of any kind has been done on the boiler setting since the initial operation, and it appears none will be required for many years. Details of the setting are shown in Figs. 6, 7, 8 and 9.

3. Superheater

The superheater was designed ultimately to produce a final steam temperature of 750 F. However, it is temporarily being operated with a final steam temperature of 500 F. The present operating requirement has been met by omitting rows of superheater tubes and by the installation of a few header by-pass nipples. The superheater is a conventional pendant-type convection unit, but its arrangement has shown a very unusual steam temperature characteristic with respect to load. Usually this type of superheater has a rapidly decreasing steam temperature with a decreasing boiler load. In this installation, however, the superheater has been arranged in such a way as to receive the maximum amount of radiant heat transfer and the radiant characteristic offsets the dropping convection characteristic, to produce an almost flat temperature curve. This is shown very clearly in Fig. 17 where the load varied over a wide range.

4. Economizer

The economizer is a conventional extended-surface unit. The water enters the economizer at the top and leaves at the bottom and the gas enters the bottom and leaves at the top. Since extended surface tubes are used, it is possible to obtain satisfactory operation with downward water flow without water hammer at all loads. This is because of the high water velocity through the economizer, preventing stratification and formation of steam pockets.

5. Air Heater

The air heater is a conventional tubular type with the gas flow upward on the inside of the heater tubes. The air flow enters the top of the air heater and leaves at the bottom, thus providing counter flow. The air flows crosswise of the tubes and makes 3 passes.

Probably the most unusual characteristic of this entire boiler installation is the ability to operate at light boiler loads with very low exit gas temperatures and still not encounter corrosion in the air heater. The air heater is provided with an air by-pass so that all or part of the air from the forced draft fan can be by-passed around the heater. The by-pass control damper is push-button operated from the control board and the operation of this damper is guided entirely from the air heater metal temperature.

Several thermocouples are attached to the air heater tubes in such a way as to measure the metal temperature. These thermocouples are connected to a selector switch on the instrument control board and the metal temperature is recorded on a temperature recorder. The selector switch is used to locate the coldest spot in the air heater

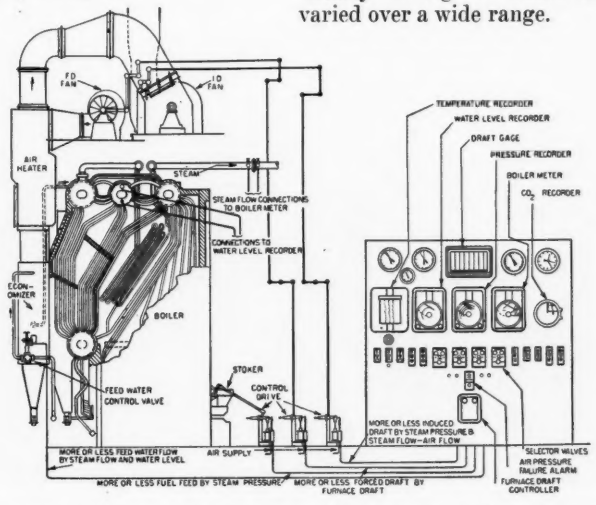


Fig. 11. Schematic diagram of the automatic combustion control system that controls the new boiler, showing details of the control panel as designed. Clock in upper right-hand corner now replaced by smoke density recorder

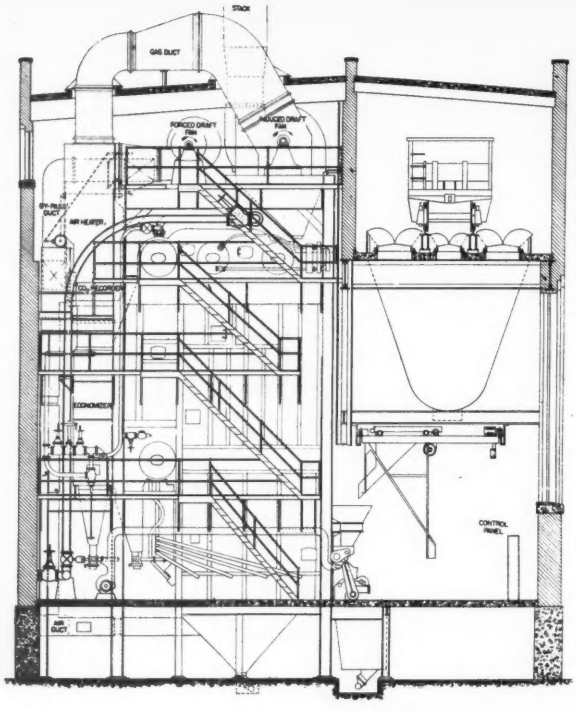


Fig. 12. Elevation of new boiler unit, emphasizing stairways and gratings, showing how they make all equipment easily accessible for ease of operation, inspection and maintenance. They saved time and money during erection of unit

by measuring the various metal temperatures and the thermocouple with the lowest reading is then put on the recorder. The recorder is equipped with an alarm and light signal, which calls the attention of the operator in case he has overlooked the metal temperature and it is getting down close to the dew point of the flue gas. The operators ordinarily open the air heater bypass before the signal operates, however.

Average Flue Gas Exit Temperature Below 250 F

This procedure has shown that the usual empirical method of estimating air heater metal temperatures from inlet air and outlet gas temperatures is wholly unreliable. Under certain conditions, the dew point may be approached by the air heater metal at a flue gas temperature as high as 300 F. At other times, the air heater metal temperature remains above the dew point with exit flue gas temperatures as low as 215 F. In fact, we operate the boiler for approximately 12 hr each day with an exit flue gas temperature below 250 F and no corrosion in the air heater has been detected to date. The fuels have ranged from 2 per cent to 4 per cent in sulphur and 10 per cent to 20 per cent in moisture during the past year.

The dew point of the flue gases is calculated and the operating points determined entirely from information and data given in an article on this subject which appeared in POWER PLANT ENGINEERING* a few years ago. We have found the procedure and data given in that article to be accurate and entirely reliable from an operation standpoint. We also referred to an article on furnace design in POWER PLANT ENGINEERING.* Also, all the economizer and air heater circulations were based on another series of articles on that subject appearing in the magazine.

6. Fans

Both the forced and induced draft fans are designed for two speed operation, namely 1170 rpm and 870 rpm. Both fans are equipped with free wheeling couplings between the fan and the motor. This coupling is intended to provide: (1) an automatic means of declutching the motor and fan when changing from high to low speed; (2) an automatic declutching means in the future when it is proposed to install a steam turbine for dual drive on each of the fans. The steam turbine was not installed at this time due to war conditions but the fans were constructed for the future dual drive arrangement.

The fans are mounted on a reinforced concrete floor entirely sup-

**Editor's Note*—The articles referred to, which the author states gave not only the basis for certain design ideas but also the actual methods of calculation, are: POWER PLANT ENGINEERING—Dew Point of Flue Gases of Fuels Containing Sulfur, by Jesse S. Yeaw and Louis Shnidman; January 1943, page 68; February 1943, page 69. It's Your Furnace, by G. Campbell Kohlar, March 1940, page 45. Air Heater and Economizer Selection, by Adolf Johnson, May 1939, page 301; July 1939, page 475; December 1939, page 773.

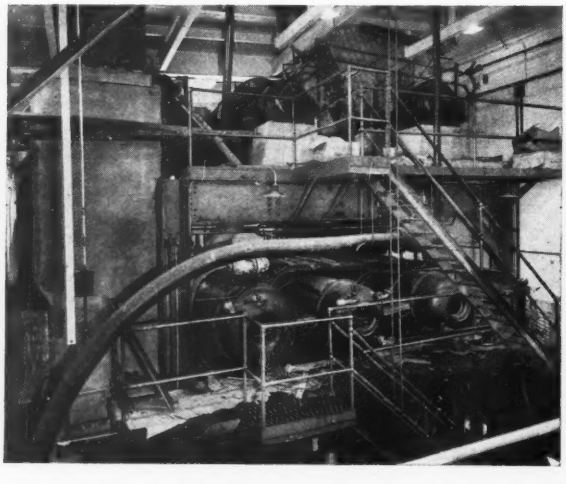


Fig. 13. View of upper drum and fan floor during construction, showing how stairways and gratings, already in place, aided erection by obviating need for staging

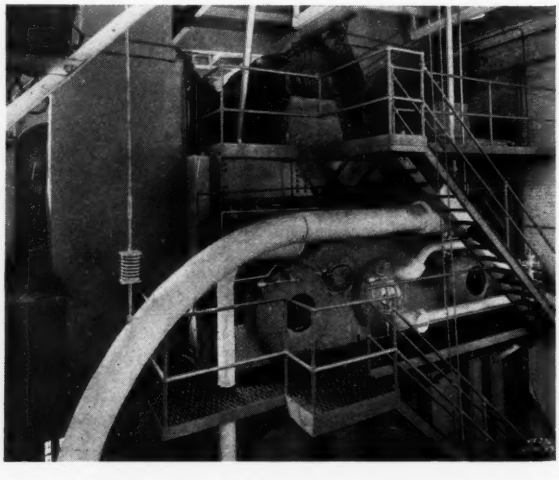


Fig. 14. View of upper drum and fan floor from exactly the same point as Fig. 13 after construction was finished, showing easy access to all equipment

ported by the main boiler columns. Extreme care was used in designing this fan floor to keep vibration at an absolute minimum. Operating results to date have proved the correctness of the design, for absolutely no vibration has been encountered.

7. Stoker

The stoker is of the new continuous cleaning spreader type, in which the grates, instead of being stationary and arranged for periodic dumping, move towards the front and continuously discharge the ash into an ash hopper located in the basement at the front of the boiler unit. This eliminates the necessity for stopping to clean fires and enables the stoker to be operated at its maximum efficiency at all times without the cleaning interruption.

The stoker is approximately 16 ft long and 13 ft wide. The grate area consists of four rotating sections, with each two sections on either side of the center line of the boiler driven independently. There are four feeders and these are also divided in the center and driven independently from each side. See Fig. 10. The plenum chamber underneath the stoker is likewise divided in the center, making it possible to operate one-half of the stoker entirely independent of the other half. The feeder drive is arranged in such a way that the feed of coal can be regulated from zero to maximum load with one stroke of the control lever. The grate speed is adjustable from the grate drive transmissions, and at the present time can be varied from zero to 7.4 ft per hr.

Over-fire air is injected into the furnace through 4 air nozzles equally spaced across the rear wall and 2 nozzles located in the corner and discharging toward the center of the furnace. The 4 center nozzles also pick up and reinject fly ash, which is trapped in the hoppers underneath the last boiler pass and the economizer. The total grate area of the unit is 183 sq ft. The stoker was designed to burn a fuel having the following analysis:

Moisture	12 per cent
Volatile	33.6 per cent
Fixed carbon	43.8 per cent
Ash	10.7 per cent
Sulphur	3.2 per cent
Ash fusion temperature	1950 F
Btu per lb as fired	10,700

The maximum burning rate per sq ft of surface is approximately 50 lb per hr.

Principal Equipment, New 100,000-lb-per-hr Boiler, Tractor Works, J. I. Case Co., Racine, Wis.

Boiler—Murray Iron Works Co. Capacity 100,000 lb per hr; designed for 425 psi, 750 F. Boiler 15 ft wide. Heating surface 6895 sq ft. Upper rear and lower drums 42 in. diam.; two other upper drums 36 in. diam. Tubes 3½ in. diam., arranged so any tube can be removed without removing others. Total water wall area 978 sq ft; projected area basis, 271 sq ft. Furnace volume 3843 cu ft. Heat release, at maximum load, present operating conditions, 32,000 Btu per cu ft per hr; future operating conditions, 35,500 Btu per cu ft per hr.
Superheater—Foster Wheeler Corp. Pendant type, convection surface 1693 sq ft for future 750 F temperature. Present surface 527 sq ft for 500 F operation. Construction all low carbon steel, no alloys used.
Economizer—Foster Wheeler Corp. Surface 3696 sq ft—extended surface type. 16 rows of tubes high, 6 rows wide, 11 ft long.
Air Preheater—Foster Wheeler Corp. Tubular type; surface 6540 sq ft.
Suspended Furnace Walls and Stoker Arch—Figel Works Corp.
Stoker—Detroit Stoker Co. Continuous cleaning spreader type. Total grate area, 183 sq ft; stoker 16 ft long, 13 ft wide; 4 feeders, 4 traveling grate sections, driven in two pairs independently. Maximum grate speed 7.4 ft per hr. Maximum combustion rate, 50 lb per hr per sq ft of grate surface.
Automatic Combustion Control—Bailey Meter Co.
Boiler Feedwater & Level Control—Bailey Meter Co.
Forced Draft Fan—Buffalo Forge Co. Designed to handle 130 F air. Capacity: 31,000 cfm at 8.5 in. H_2O static pressure, 1170 rpm; 23,000 cfm at 5 in. H_2O static pressure, 870 rpm. Drive, two-speed motor.
Induced Draft Fan (cinder catcher-type) — Buffalo Forge Co. Designed to handle combustion gases at 350 F. Capacity: 45,700 cfm at 8.8 in. H_2O static pressure, 1170 rpm; 34,000 cfm at 5 in. H_2O static pressure, 870 rpm. Drive, two-speed motor.
Breeching and Stack—Murray Iron Works Co.
Boiler Feed Pump—(Aldrich-Groff)—Aldrich Pump Co.
Ductwork—Murray Iron Works Co.
Boiler Steel—Murray Iron Works Co.
Boiler Setting—Orser Construction Co.
Boiler Insulation—(A. P. Green's Vermiculite)—Geo. H. Fredericks & Co.
Soot Blowers—Vulcan Soot Blower Co.
Water Columns—The Reliance Gauge Column Co.
Ash-handling Equipment — United Conveyor Corp.
Main Steam & Feedwater Piping—Advance Heating Co.
Piping Insulation—Spinkman's Sons
Valves:
- Safety—Manning, Maxwell & Moore
- Non-return—Crane Co.
- Gate & Globe—Edward Valve & Mfg. Co.
- Blowoff—Okadee Co.

Feedwater Treatment System—Permutit Co.
Boiler Construction—Murray Iron Works Co.
Instruments:
- Indicating Gages—Crosby Steam Gage & Valve Co.
- Draft Gages—Bailey Meter Co.
- Boiler Meter—Bailey Meter Co.
- Recorders (Steam & Water Flow, Pressure, Etc.)—Bailey Meter Co.
- Temperature Recorders (Micromax) — Leeds & Northrup Co.
- Thermometers, Thermo-couples, etc. — Leeds & Northrup Co.
- CO_2 Recorder—Republic Flow Meters Co.
- Fan Motor Control—Cutler-Hammer, Inc.
- Smoke Density Recorder—Leeds & Northrup Co.

Driving Motors:
- F. D. Fan, I. D. Fan, Stoker—General Electric Co.
- Boiler Feed Pump—Allis-Chalmers Mfg. Co.

Gratings & Stairways—J. I. Case Co.

Table I. Coal Test Summary—New 100,000-lb-per-hr Boiler—Tractor Works Plant

Average load on boiler	92,210	lb per hr
Average steam temperature	510	F
Average steam pressure—(Drum)	190	psi
Average steam pressure—(Sup. Outlet)	175	psi
Heat content per lb steam	1,274	Btu
Heat content per lb feedwater	183	
Net Heat Added by Boiler:	1,091	Btu
Lb steam made	922,105	lb
Coal used	84,761	lb
Btu of coal as fired	13,400	Btu per lb
Lb steam per lb coal	10.8789	
Boiler Efficiency $= \frac{10.8789 \times 1091}{13{,}400}$	88.565	per cent
Heat Balance:		
Heat absorbed by boiler unit	88.565	per cent
Loss due to moisture in coal	0.872	per cent
Loss due to hydrogen	3.72	per cent
Loss due to moisture in air	0.103	per cent
Loss due to dry chimney gas	4.8	per cent
Loss due to unburned carbon	0.74	per cent
Loss due to radiation, unaccounted for	1.2	per cent
	100.000	per cent
Average CO_2	15	per cent
Gas Analysis		
CO	0	per cent
O_2	4.3	per cent
Average stoker burning rate	46	lbs per sq ft
Average furnace heat release	29,600	Btu per cu ft per hr

Table II. Performance Data—New 100,000-lb-per-hr Boiler—Tractor Works Plant—Load 95,000 lb per hr

LOAD	95,000	lb per hr		
Boiler Drum Pressure	187	psi		
Superheater Outlet Pressure	163	psi		
Pressure Drop Across Superheater	24	psi		
Economizer Inlet Water Pressure	206	psi		
Economizer Outlet Water Pressure	197	psi		
Pressure Drop Across Economizer	9	psi		
Steam Temperature	510	F		
Per cent CO_2	15.3			
Exit Gas Temperature	275	F		
Air Heater Inlet Air Pressure	5.75	in.		
Air Heater Outlet Air Pressure	3.8	in.		
Air Pressure Loss Across Heater	1.95	in.		
Air Press. in Stoker Plenum Chamber	2.3	in.		
Air Pressure Loss in Ducts and Blast-gates	1.5	in.		
Furnace Draft	0.18	in.		
Air Pressure Differential Across Stoker Gates	2.48	in.		
Boiler Outlet Draft	0.85	in.		
Boiler Draft Loss	0.77	in.		
Economizer Outlet Draft	4.4	in.		
Economizer Draft Loss	3.55	in.		
Air Heater Outlet Draft	6.2	in.		
Air Heater Draft Loss	1.8	in.		
Stoker Grate Speed	5	ft per hr		

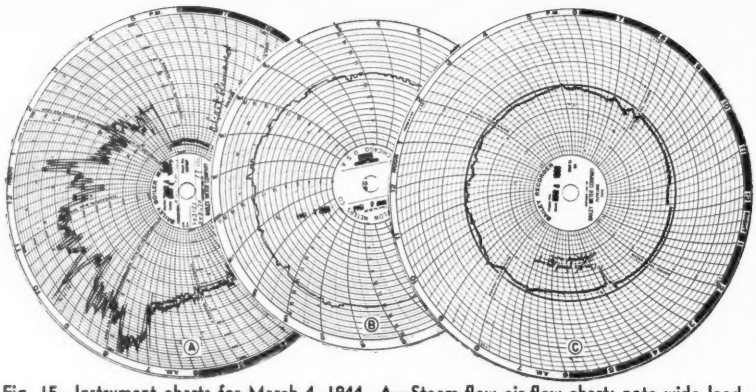


Fig. 15. Instrument charts for March 4, 1944. A—Steam-flow air-flow chart; note wide load savings and low load of 10,000 lb per hr from 4:00 to 7:00 pm; B—CO_2 recorder chart for same period; C—Water level recorder chart for same period. Note stability with large load swings

8. Design for Accessibility

One of the aims sought in the design of the new unit was complete accessibility of all equipment for ease of operation, inspection and maintenance. Although the new boiler unit was installed in the existing boiler house with no building alterations, it was laid out so that every part is easily accessible. There is not a single valve, door or manhole opening, or other equipment requiring attention for operation, inspection and maintenance, that cannot be easily and quickly reached from the permanent stairways and walkways around the boiler. See Fig. 12.

Very careful study and consideration was given to this. The stairways and gratings were installed immediately after boiler steel work had been erected and we are quite confident that sufficient time was saved in the erection of the boiler unit to completely pay for the cost of the grating installation. We also feel that the permanent stairways and gratings contributed materially to the safety in erection and construction of the unit, by eliminating the necessity for temporary platforms, ladders and other unsafe arrangements.

Figures 13 and 14, views taken from the same point at the upper drum level, show how the stairways and gratings first helped in erection and now give access to drum manholes, valves, water columns, etc.

It is our belief that too much attention cannot be paid to such detail of accessibility, convenience and ease of operation. The designers and equipment manufacturers merely set the stage for the play; the operators must put it across. Their success in doing so depends a great deal on the ease with which it can be accomplished.

9. Combustion Controls and Instruments

Although the layout of the boiler control panel, Fig. 11, seems conventional, here again a number of details were incorporated that add to the operator's convenience and make it easy for him to give close supervision over all operating factors. For example, all main dial type indicating gages at the top of the panel are duplex gages with two pointers indicating on one dial. Each pointer indicates a separate and independent pressure. For example, one pointer shows the pressure in the boiler drum while the other pointer on the same scale shows the pressure at the superheater outlet. The difference between the two pointers is, of course, the pressure drop across the superheater, which can thus be determined at a glance. In the same way, another gage indicates economizer inlet and outlet pressures, and inlet and outlet pressures of the feedwater regulating valve.

All the temperatures of the entire boiler unit are recorded on a 10-point strip chart recorder; a section of its chart is shown in Fig. 17. Other recorders, controls, signal lights, etc., are mounted as in Fig. 11, thus centralizing all control at this point.

The combustion control is a pneumatic-operated system connected as shown in Fig. 11. Feedwater control system is of the two-element type, operating a valve in the feed line from both the boiler water level and steam flow.

All the control drive units are mounted on the operating floor immediately in front of the control panel, for ease of operation and for accessibility, if it should become necessary to operate manually. The entire control linkage system, Fig. 11, is mounted in rigid anti-friction bearings, with ball-and-socket joints at all connection points, and is counter-balanced.

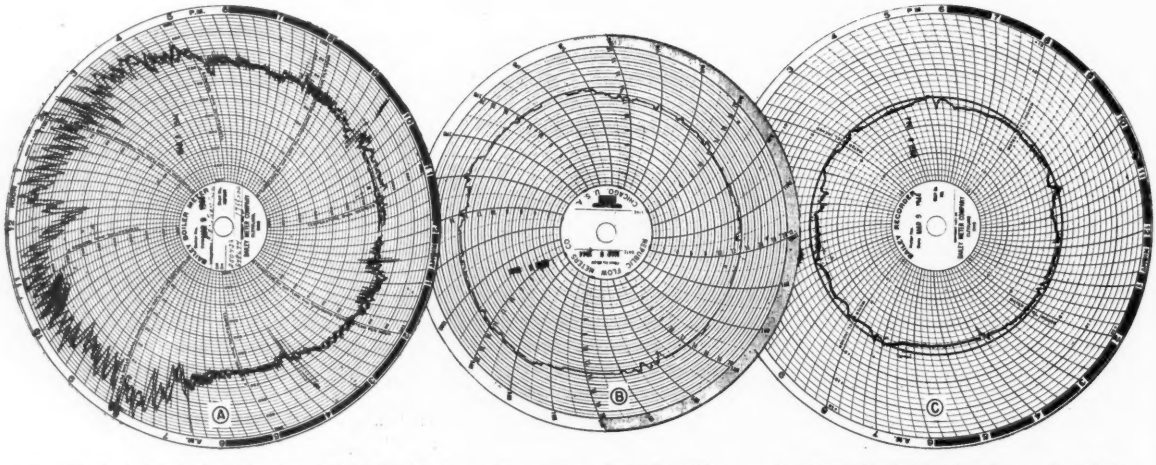


Fig. 16. Instrument charts for March 9, 1944. A—Steam-flow-air-flow chart; B—CO_2 recorder chart; C—Water Level recorder chart

10. Water Treating Equipment

Feedwater makeup is treated in a completely automatic sodium and hydrogen combination zeolite softening system, set in the boiler room near the side of the new boiler. This unit operates automatically and requires no attention from the operator other than a periodic check on the flow rate proportion through the sodium and hydrogen softening units to give the desired final alkalinity. The supply of acid for the hydrogen unit and salt for the sodium unit must be periodically replenished. The softening unit is equipped with a complete alarm system, which signals when anything is out of order.

Treated water is stored in a 15,000-gal steel tank just outside the boiler room and all the water from the softening unit discharges into this tank. To keep this tank from freezing in winter, automatic provision is made to overflow the feedwater heater and allow hot water to pass to the tank, so as to maintain the temperature in it at approximately 40 F. This obviates the need for any coils in the tank.

Operating Experience and Performance Data

Initial operation of the new boiler unit was very unusual because of the conspicuous absence of operating difficulties. Ordinarily, in a unit as large as this, numerous "bugs" must be eliminated before satisfactory operation is obtained. In this case, however, not one change or difficulty was encountered and when the boiler was put into operation it was not necessary to take it off the line at any time to make changes or alterations to the arrangement or any of the equipment. After the boiler had been operated for about six weeks, it was taken off the line for an inspection and an examination. This inspection revealed no unusual conditions and the unit was immediately put back into operation.

In some new boilers, it is necessary to make changes in the superheater to get the desired final steam temperature. In this case, the design temperature was attained within five degrees and no change of any kind has been necessary to maintain this design temperature.

The only difficulty which has been experienced in the operation of the boiler unit has been corrosion on the water side of the economizer. This was due to failure of the existing feedwater heater to properly deaerate the water. However, this condition was quickly brought under control and no further difficulty has been experienced. A new type of deaerating feedwater has been worked out by the company engineers in co-operation with one heater manufacturer and will be installed soon.

Fuel Now Coal-Coke Breeze Mixture

At the present time the boiler unit is burning a mixture of coal and coke breeze in the proportion of 75 per cent coke, 25 per cent coal. Coke breeze has been used to help in relieving the shortage of bituminous coal in the country; at the same time it makes a substantial savings in fuel cost. We are currently using about 150 tons of breeze per week, and this rate has been maintained since about February, 1944. It is anticipated that we may be able to increase this consumption of coke breeze in the near future.

Before regularly using coke breeze, it was necessary to do considerable experimenting to develop the operating technique. At first it was attempted to burn 100 per cent coke breeze, with no coal at all.

(*Continued on page* 136)

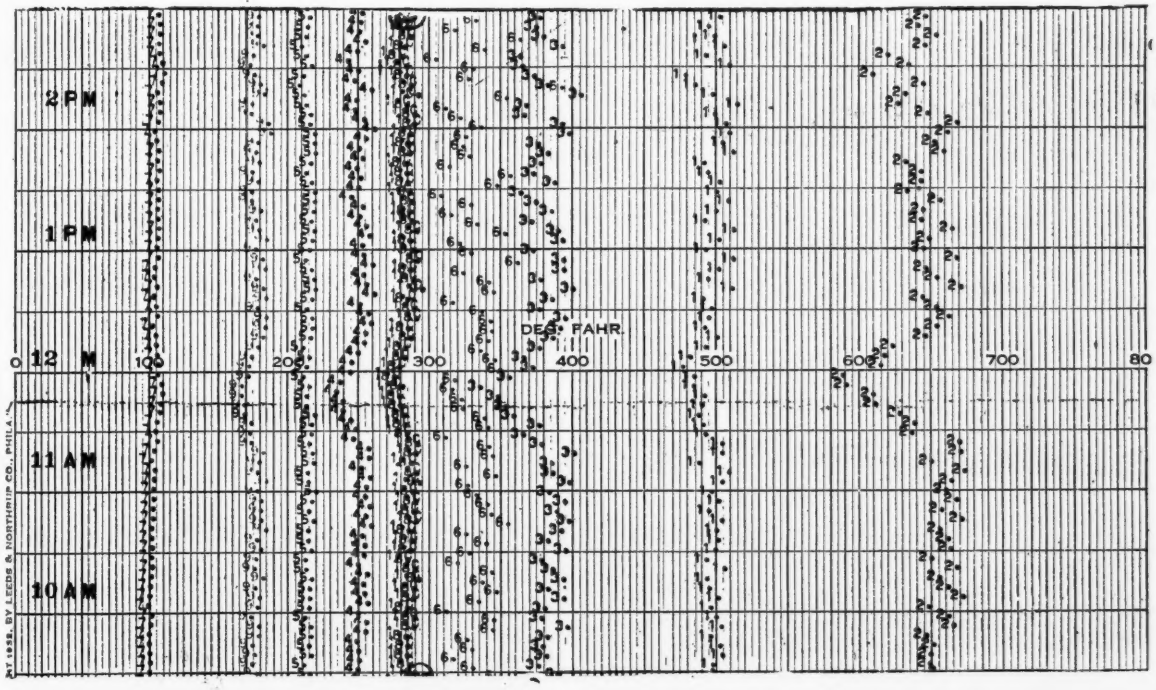


Fig. 17. Section of chart from 10-point temperature recorder for March 9, 1944. Refer to Fig. 16. Temperatures recorded:

1—Steam temperature
2—Gas temp leaving boiler, entering economizer
3—Gas temp leaving economizer, entering air heater
4—Gas temperature leaving air heater
5—Water temp entering economizer
6—Water temp. leaving economizer
7—Air temp. entering air heater
8—Air temp. leaving air heater
9—Air heater metal temperature
10—Air temp, stoker plenum chamber

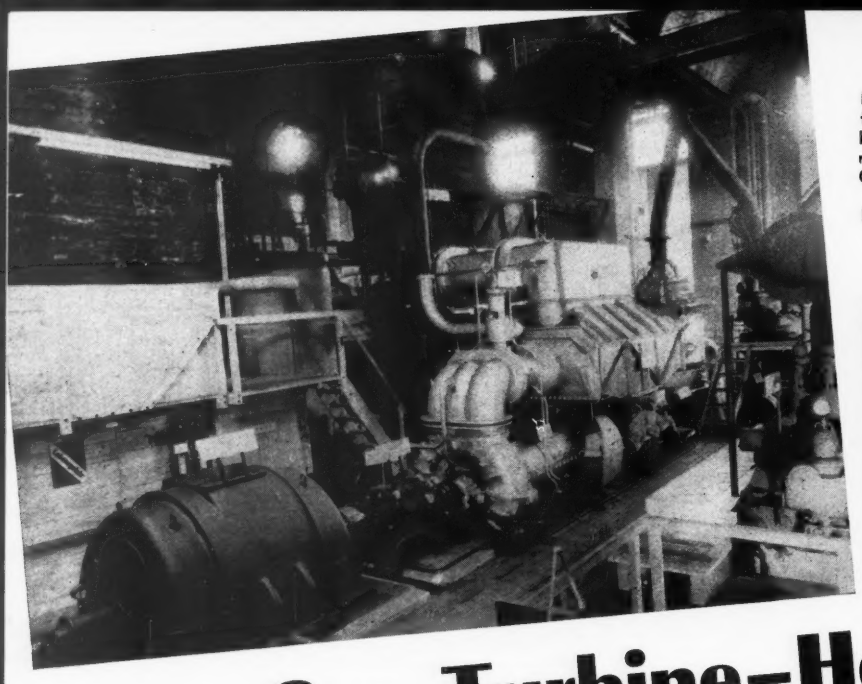
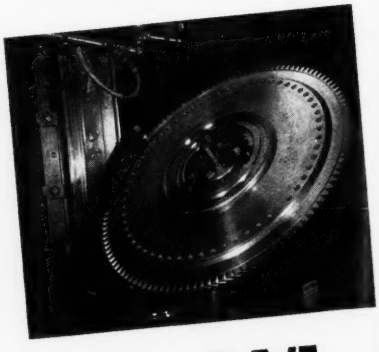
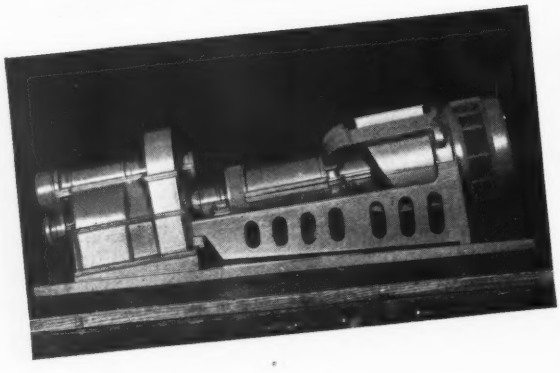


Fig. 1—Left. Experimental pulverized-coal-fired combustion gas turbine on test floor at Baden, Switzerland. No data yet available, nor just around the corner. Brown-Boveri & Co., Ltd. See also Fig. 3, page 80, March, 1944, issue

Fig. 2—Below. Gas turbine rotor disc being broached for blading. Elliott Co.



The Gas Turbine—Here's What



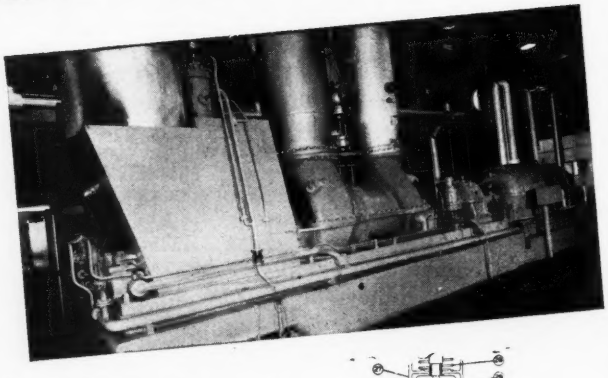


Fig. 3—Above, Left. Model of a marine gas turbine power plant. Left to right: gear, axial-flow compressor, exhaust and cross-over ducts to combustion chamber, turbine, screen covering combustion chamber. General Electric Co.

Fig. 4—Above, Right. Gas turbine unit, 60,000 cfm at 50 psig installed in connection with Houdry process. Allis-Chalmers Mfg. Co.

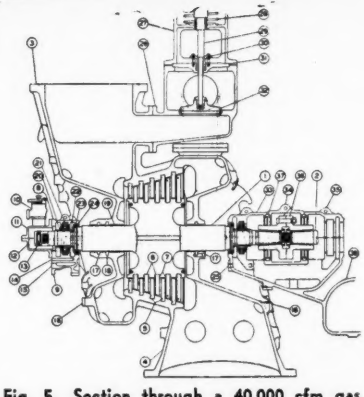


Fig. 5. Section through a 40,000 cfm gas turbine. Allis-Chalmers Mfg. Co.

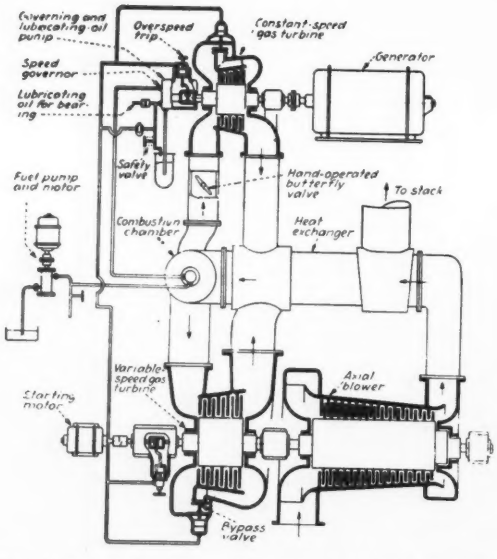


Fig. 6. Schematic diagram of a complete double-unit gas turbine power plant. Brown-Boveri & Co., Ltd.

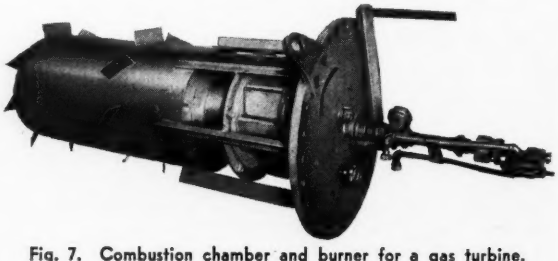


Fig. 7. Combustion chamber and burner for a gas turbine. Allis-Chalmers Mfg. Co.

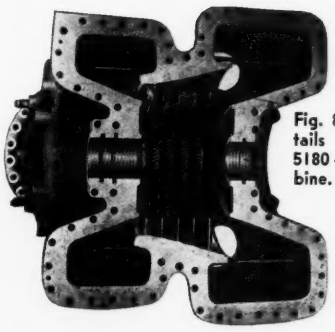


Fig. 8. Cylinder details of 6600-hp 5180-rpm gas turbine. Allis-Chalmers Mfg. Co.

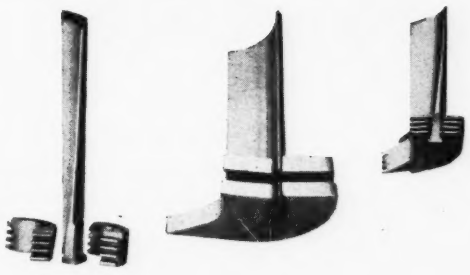


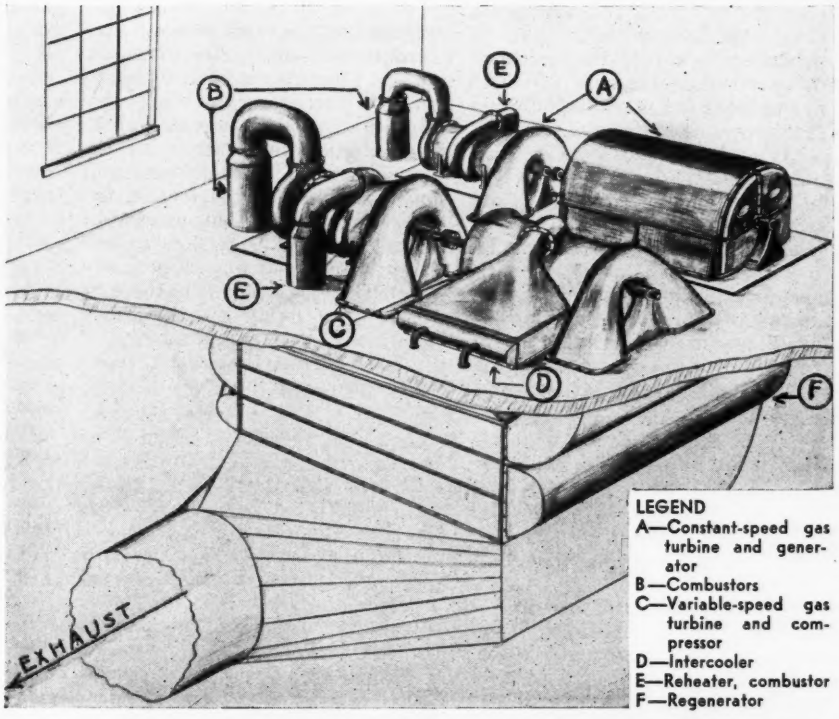
Fig. 9. Gas turbine blading. A (Left) — Spindle blading and spacer pieces. B (Center)—Cylinder blade assembly. C (Right) — Spindle blade assembly. Allis-Chalmers Mfg. Co.

...at the Equipment Looks Like

Fig. 10. Artist's conception of a 5000-kw open cycle gas turbine power plant, Westinghouse Electric & Mfg. Co.

GAS TURBINES have been actually in operation both in this country and abroad for some time. These illustrations give some idea of what they are like. In connection with the Houdry process for producing high-octane gasoline, some 36 gas turbines are in operation in the United States. Eight of these were built by Brown-Boveri & Co., Ltd., of Baden, Switzerland, the remainder by Allis-Chalmers Mfg. Co. of Milwaukee, Wis. Several other gas turbine units, such as the General Electric unit shown on page 79, March 1944 issue, are in use in oil refineries.

No gas turbine plant for operation solely as a stationary prime mover, that is for the sole purpose of driving an electric generator, has yet been installed in this country. So far, the only straight gas turbine electric generating plant installed is the installation at Neuchatel, Switzerland, March, 1944, issue. This is a simple open-cycle unit, designed for standby emergency service.



LEGEND
A—Constant-speed gas turbine and generator
B—Combustors
C—Variable-speed gas turbine and compressor
D—Intercooler
E—Reheater, combustor
F—Regenerator

Fig. 11—Below. Gas-turbine rotor during precision machining operations. Elliott Co.

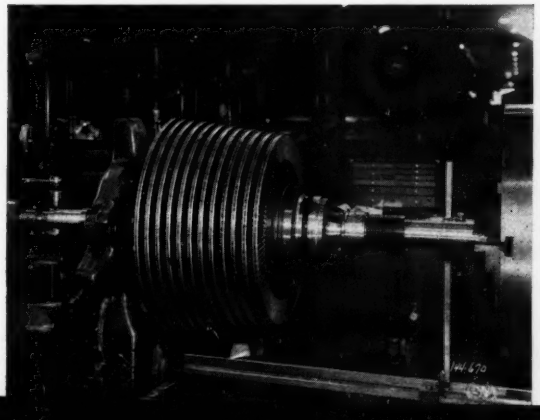
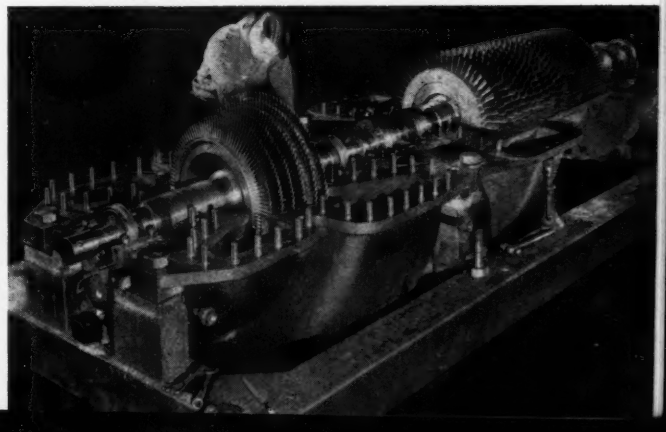


Fig. 12—Below. Gas turbine unit with upper half of casing removed, showing characteristic appearance of turbine and compressor rotors, blading, cylinder construction. Allis-Chalmers Mfg. Co.



A Study of Coal Sizing

New pricing system based on coal quality and suitability advocated . . . Coal sizes reduced by handling . . . Combustion efficiencies of some burning equipment reduced by fines in coal bed . . . Uniform sizes stock best . . . Small sizes well suited for mechanical stoking . . . Ash content of coals reduced by washing

By Joseph Harrington — *Advisory Engineer on Coal and its uses*

IT IS DOUBTFUL whether there is any one thing in the whole list of attributes of coal for heat generation that is of more importance, or more often the basis of controversy, than the matter of size. The attempt on the part of producers to satisfy the, at times, overparticular demands of users has resulted in a multitude of sizes that verges on the absurd.

If coal were a substance that, once mined and prepared, stayed in just that condition, many of our troubles would be over. Unfortunately, however, it starts to change the moment it is out of the mine, and continues to change with every day's exposure and with every handling. The result is that a carefully prepared size may start from the mine all right but after a week in a freight car and two or three handlings by shovel, clam-shell or elevator, ends up with nearly every piece reduced in size and much of it reduced to dust.

Coals vary greatly in this size change but none are entirely free from it, and some suffer to the extent of 15 or 20 per cent. It would seem perfectly obvious from this that the initial sizing of coal to one-sixteenth inch limits simply means nothing but confusion and misunderstanding. In fact, it implies a precision that cannot be maintained and engenders a feeling of resentment when a precisely described coal arrives in the customer's bin in an unrecognizable condition.

This defeats the honest desire of the producer to supply his customer with a coal that really suits his equipment.

That the customer really has a grievance when his coal runs 15 or 20 per cent fines, instead of the clean lump or nut he ordered, needs but little supporting argument.

Every stoker operator knows what happens when his coal is loaded with excessive fines especially if they happen to be wet. On the chain grate the fines produce excessive siftings, plug up the air spaces and increase fuel bed resistance. This calls for more draft which may not be available. If of the forced-blast type, high pressure simply blows holes in the fire and produces bad conditions all around.

With the spreader stoker excessive fines make a lot of fly ash, and by adhering to the side walls either produce erosion or accretions.

With the screw underfeed, the fines are sure to segregate, overload the fire at the back end, producing uneven fuel bed conditions and probably clinkers.

And so it goes through the entire list. When a buyer orders any specific thing, certainly it is only fair to assume that he wants what he ordered. Coal being what it is calls for a carefully considered technique in its production, preparation, transportation and use.

While the initial responsibility for coal sizing rests with the producer, it must be admitted he has no control over his product after it leaves his hands. Once loaded on the cars, the next one actually to handle the coal is the dealer or the user.

In the case of the dealer we have two handlings interposed between producer and user—unloading and stocking, and reloading on trucks. In some yards this is done mechanically with but little regard

Fig. 1. This method of stocking packs coal firmly and is employed to advantage where screenings can be used

for free fall and consequent breakage. The entire technique of yard handling could be studied to advantage.

When it comes to the final step in its travels towards the furnace, there is but little visible effort on the part of the coal passer or unloader to minimize breakage. In fact, it would seem to be about the last thing in the world to worry about!

Coal has been so abundant and so cheap that but little thought has been given to preserving its original size. As long as values are based on size, careful thought should be given to preserving the size it was intended to have.

Size Segregation

Success in stoker operation depends very largely on establishing a regular uniform combustion rate throughout the fuel bed regardless of the type of stoker in question. At constant warfare with this requirement is the inevitable separation of the different sizes whenever coal is permitted a free fall. As long as the force of gravity continues to cause movement, the larger pieces will roll down the sides of a pile until they reach a resting place at the bottom, whereas the finer portions will stick together and remain at the top and center of the pile. This is especially the case when the finer parts are damp and very emphatically the case whenever the size difference is great.

When coal thus automatically separated into its various sizes reaches stoker grate surface, it will afford areas of reduced resistance to the flow of combustion air and other areas highly resistant to such flow. These areas will burn out at different rates and holes will develop in the fuel bed which are destructive of efficiency.

This phenomenon is especially the case with chain grate or other progressive combustion stokers, hand fired, or other types wherein the fuel bed is in a relatively thin and supposedly uniform state. It is not quite so obvious with those types of stokers in which the fuel bed is mixed up in the very process of firing the fuel but even these types of stokers are by no means immune from this trouble. An uneven fuel bed even in the larger types of multiple retort stokers is highly undesirable.

Just as surely as there are widely differing sizes in a load, there will be size separation whenever the load is dumped. This is inevitable in piles or bunkers and even in stoker hoppers. No stoker can perform efficiently with some coal two inches in size and some one-quarter or smaller, unless thoroughly and evenly mixed. Such uniformity is almost impossible to maintain.

An uneven fuel bed offers greatly differing resistance to combustion air, burns out unevenly, produces coke in the pit and bad furnace conditions. Production of fines due to rough handling anywhere along the line should be carefully avoided.

Uniform fuel pays dividends big enough to attract the attention of any management.

Storage Coal

The present necessity for stocking coal in piles outdoors introduces a new element in the sizing difficulty. Here we have in rather accentuated form the causes of size degradation; namely, exposure to weathering for extended periods and at least two extra handlings. Since coal stocks are almost invariably carload delivery, the unloading either by shovel or clamshell involves a lot of breakage and production of fines.

It is a well established principle that coal for stocking should be larger than two inch bottom size to start with and be handled as little and as carefully as possible. If the power plant can use the coarser coal or is equipped with a crusher, the top size of the piled coal makes no difference. If, however, the plant must have screenings, the proper thing would be to lay down a coal with a somewhat larger consist than required, and then pack it firmly to exclude air and make it safe against heating.

It is not necessary to elaborate upon the many details that go to make up a complete story of coal storage. A brief summary, however, will be found convenient:

1. Select a level spot on good, dry, firm ground without drainage pipes, sewers, tunnels or ditches.
2. Clean the ground of all refuse matter, giving special attention to wood, vegetation, discarded waste, old clothing or similar combustible matter.
3. Select the type of storage in view of the kind of coal desired and the utilization equipment.
4. Do not store different kinds of coal in the same pile.
5. Do not put fresh coal on top of an old pile, of either the same or different kind.
6. If fine coal is to be stored, observe the instructions regarding compacting the coal solidly to the very edge.
7. Check the temperature once a week for the first three or four months, unless the pile has been coated by the Wattles system. Do not disturb a pile thus protected.

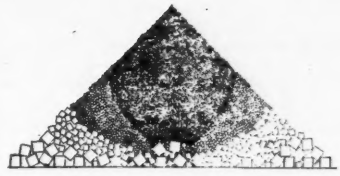


Fig. 2. Typical segregation of difficult sizes of coal in a conical pile

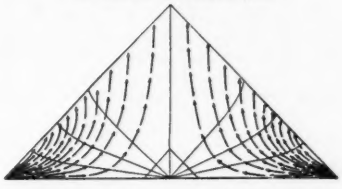


Fig. 3. Lines indicating paths for air circulation in a pile of coal with an attempt to show that circulation is more difficult in the center than near the edges

Present Sizes

The number of sizes of midwestern coal that have been made seem actually ridiculous when the inevitable changes due to shipment and handling are appreciated. A coal that leaves the mine one size invariably arrives at the boiler room another size. The extent of such degradation is a function of the initial hardness of the coal, the weather conditions and the treatment it has received in its travels from mine to boiler room. Even if all these things were exactly alike with two coals, we still have several reasons why they may not conform to their size names when they leave the tipple.

Custom has established a certain procedure relative to sizing coal. The run of mine is passed over a series of shaker screens with different sized holes and the various sizes separated accordingly. Such a procedure results in an acceptable size separation if certain standards are adhered to. The slope of the screen and the extent and rapidity of oscillation affect the thoroughness of the process. If the normally round holes in the screen become worn to ovals, the top size of the "through" is increased and the bottom size of the "over" also increased.

Size Value

Our present system of prices is based largely on the size of coal pieces. Large lump commands the highest prices, small lump some-

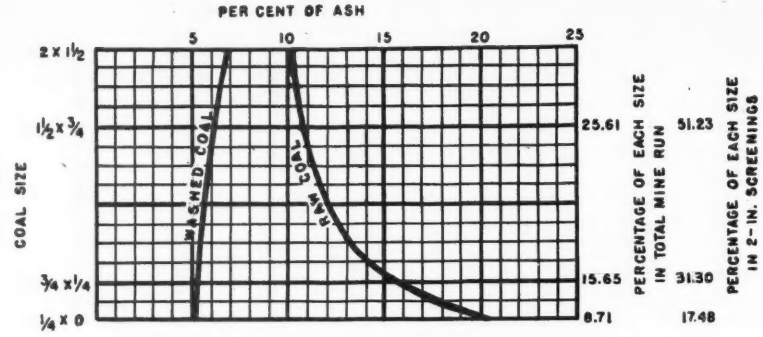


Fig. 4. Curves showing ash content in various sizes of coal

what less, and so on down through egg, nut and pea to slack or screenings. This can probably be explained as an inheritance from the time when cleaning methods actually did cause all the "dirt" to fall into the small sizes. Today the reverse is the case. As the coal is broken down, the impurities are released and removed in the washing or cleaning process so that in reality the finest sizes are often the lowest ash coal in the entire list.

This is well illustrated in the accompanying graph. The raw coal curve was obtained before the washer was built and shows how consistently the "dirt" kept falling into the smaller size.

The curve for washed coal shows the effect that washing has as the size decreases. While both coals were from the same mine, a change in the physical characteristics of some of the impurities affected the washability of the largest sizes.

Many mines with washers are afflicted with this trouble which is due to a difference in the shape of the larger pieces rather than their specific gravity.

Certain coals have the characteristic of breaking into flat slabs or plates instead of more or less spherical pieces. These "flats" will not sink in the wash box as rapidly as their specific gravity would indicate and, as a consequence of this slow sinking, some of them get carried over the lip of the wash box into the good coal. Means are now available for separation of these impurities on the basis of their shape only but in the instance illustrated such means were not in effect.

This fact simply nullifies all the old notions about the coarse coal being the best from the ash angle. On top of this is the increasing use of mechanical stokers, all of which require the smaller sizes of coal, especially the domestic type. When such stokers become as universally accepted as the vacuum cleaner, electric refrigeration or a dozen other clean, automatic devices around the house, the day of the high-priced lump is over. What then will become of mine realization, dependent today upon those high-priced large sizes?

Just exactly one thing *can* happen, and this is a complete abandonment of the present price basis and a new system established upon a QUALITY-SUITABILITY basis. Size will disappear as a factor in the price of coal to be replaced by two things: first, the intrinsic value or Btu content and second, the availability of such heat value in consideration of the character of the consuming apparatus. The "suitability" is used to include the qualities of ash quantity and fusibility, coking tendency, volatile and physical structure, always having in mind the nature of the stoker, furnace or service involved. Size, as a cost factor, will simply disappear. Sizing of coal will merely be an element in adapting this fuel to the physical requirements of the stoker or other service.

So much has been said about "fines" that the question naturally arises as to what use they can be put or must they be thrown away simply because they *are* fines. The application of the Q-S formula adequately answers this query. They are probably well suited to powdered coal burning, briquetting or some other special purpose.

Sizes Suggested

The anthracite people have beaten us to a size simplification that we would do well to follow. They have exactly eight sizes, named as follows: Broken, Egg, Stove, Chestnut, Pea, Buckwheat, Rice and Barley, passing over screens with holes from 3¾ in. down to 3/32 in. How much more simple and intelligent it would be to forget the fifty sizes now burdening the price lists of the bituminous industry and adopt a similarly simple yet sufficient system.

Here are the sizes the writer would suggest:

Plus 6 in.
6 by 3
3 by 2
2 by 1½ or 1¼
1½ or 1¼ by ¾
¾ by ¼
¼ by ⅛
¼ by 0
⅛ by 0

Each size has top and bottom limits so near together that no segregation occurs in bunker, pile or hopper. Without exception every one of these sizes are now standard and accepted by both producer and customer. Moreover it is possible in practically every tipple to combine or blend the sizes so that any grouping or adjacent sizes could be made. For illustration, the so-called two-inch screenings would simply be a blend of everything from two-inch to zero. Stoker nut would combine say the 1¼ by ¾ and ¾ by ¼.

It may be said that this system can result in a multitude of sizes, which is true to a certain extent just as it would be with anthracite. But the point is that the anthracite customer has been educated to accept the standard sizes for this coal and does not demand a multitude of odd, intermediate sizes.

The day is not far distant when practically all bituminous coal will be mechanically stoked, and as previously stated, this will mean that practically all such coal will be under two inches top size. Without the realization produced by the larger sizes, the price of the smaller sizes must be increased or the producer will go broke. It is time that the industry take heed of this trend and do some long distance planning. With the size element thus automatically eliminated, the whole system of pricing coal must be revamped. The fundamental considerations of quality and suitability must ultimately govern just as they do today with hats, shoes or overcoats. In a free and unrestricted market every coal would soon reach its normal value and the sound incentives of good preparation and proper selling would result in putting coal in its rightful place as the world's safest, cheapest and best fuel for the majority of modern needs.

H. V. Interconnection Made Reliable by SINGLE POLE SWITCHING

By J. J. TRAINOR, Chief Engineer, Public Service Co. of Indiana, Inc.
And
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The advantages of single-pole reclosing breakers in increasing the transient stability limits during single line-to-ground faults are not generally appreciated except by those who have worked with this type of equipment on interconnected systems. The advantages of multi-pole reclosing breakers are well known but the single-pole reclosing breaker offers advantages over those of the multi-pole breakers because considerable power is transmitted over the unfaulted phases while the troubled phase is isolated. In this article, the authors review the history of the single-pole breaker and show how its application in transmission line circuits has made high voltage interconnections more reliable

DURING THE SPRING of 1941 the first installation of high-speed, single-pole reclosing, as applied to high-voltage transmission circuits, went into service. The application was to the newly constructed 132-kv circuit of the Public Service Company of Indiana, Inc., extending from Lenore to New Castle substations. Subsequent to this installation descriptive articles 1, 2, 3[1] were published giving the details of the job, the reasons for choosing single-pole switching rather than more conventional methods, and discussing tests as well as expected performance. During the last two years the use of single-pole reclosing has been extended to several other new high-voltage circuits and these will be discussed.

Why Reclosing?

The advantage to be gained through the use of high-speed reclosing circuit breakers has been recognized ever since fast operating circuit breakers and high-speed relays have been available. A multiplicity of installations on high-voltage systems have been made to increase the reliability of transmission systems and raise transient stability limits.

With the advent of extensive system interconnections to obtain diversity of generating facilities and a maximum of operating reliability, the importance of high-speed reclosing greatly increased. The situation has been further accentuated by the wartime necessity for conservation of materials which practically dictates single-circuit lines for such system interconnections. Only through the application of high-speed reclosing have many of these single-circuit interconnecting lines been made of sufficient reliability to be called firm sources for transmitting power between systems. Not only is a fault on such lines cleared promptly, but the line is reclosed rapidly after fault isolation before the two synchronized systems drift far enough apart to cause loss of stability after the line is re-established.

It is not implied that high-speed reclosing does not have application on any but single-circuit lines. Definite advantages can be proved for reclosing on multi-circuit lines. The application can be considered as an alternative to the construction of additional circuits if higher transient power limits are a requirement, and will usually result in large savings in capital investment compared to new line construction.

In the past, reclosing has generally referred to gang operation of circuit breakers; that is, when a transmission fault occurs all three phase poles of the circuit breakers at both ends of the line are tripped and reclosed simultaneously. It is essential that the breakers at both line terminals trip simultaneously, since complete fault isolation is necessary if the fault-arc is to deionize and permit successful reclosure. Obviously, the total reclosing time would be greatly lengthened if sufficient time for arc clearing had to be allowed without concurrent opening of both circuit breakers. This qualification dictates carrier current or pilot wire relaying, though where possible, high-speed impedance-type relays may be set to cover the entire line section in the instantaneous tripping zone. Reclosing time is measured from the instant of trip coil energization until the breaker contacts open and again touch on the closing stroke. Such gang-operated reclosing breakers are commercially available in the higher voltage classes with reclosing times of 35, 30 and 20 cycles on a 60-cycle basis. The reclosing time selected will usually be based on maximum transient power limits required.

One Step Further

The foregoing has referred specifically to simultaneous operation of all breaker phase poles for all types of transmission line faults, and is commonly called three-pole or gang-operated reclosing. Even employing high-speed relays and breakers, and operating these breakers at the highest possible reclosing speeds, cases can arise where the desired maximum power cannot be transmitted without instability occurring during faults. Single-pole switching and reclosing of the circuit breakers offers a solution for such cases by greatly augmenting transient stability limits during single line-to-ground faults. By opening only the breaker pole associated with the faulted conductor, and reclosing this pole after the fault has cleared and the fault path de-ionized, the critical power limit is raised over that obtained with gang-operation for the same total reclosing time. The reason is simply this: considerable power is transmitted over the two unfaulted phases while the troubled phase is isolated, and synchronizing power continues to flow between the connected systems during the entire opening and reclosing operation; while three-pole reclosing temporarily creates complete electrical isolation of the two systems, and no synchronizing power flows.

Conversely, since higher stability limits obtain for the same re-

[1]See reference list at end of article.

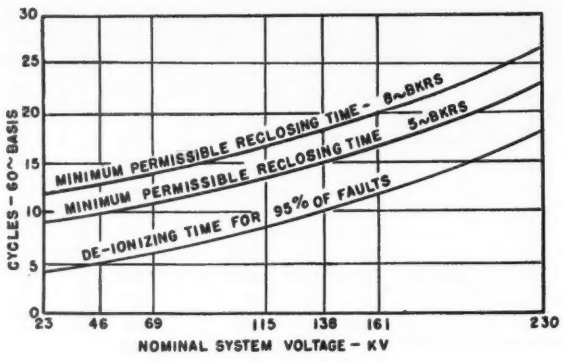


Fig. 1. Typical arc de-ionizing times

closing time when single-pole reclosing is employed, longer reclosing time can be used to get a stability limit equal to that reached with gang operation. This may be of value in providing a longer time for arc de-ionization and consequently a greater assurance that the reclosure will be successful. A rough guide to necessary arc de-ionizing time can be had by reference to Fig. 1, which is reproduced from earlier articles (3, 4) and is the result of tests on typical systems. The times shown are variable, depending upon clearances, wind velocity, etc., but give some quantitative indication under average conditions. An examination of Fig. 1 leads to another observation, that in very high-voltage systems, probably above 138 kv, where the reclosing time necessary to maintain stability with gang switching may be less than that required for arc de-ionization, single-pole reclosing permits slower speeds, thus providing ample time for the arc to clear.

The advantage of highest transient stability limits associated with high-speed single-pole reclosing applies only during single line-to-ground fault conditions. During multi-phase faults the switching can be arranged to perform in the conventional manner, that is, all phase poles open and reclose. Operating experience indicates that about 70 per cent of all transmission line faults originate as single line-to-ground disturbances, and on new lines the design can be controlled so that an even larger percentage will be probable. These figures prove that the advantage is realized for most disturbances.

System Shock

Thus far the improvement in transient power limits has been set forth as the principal advantage accruing from the use of single-pole switching. Actually, while this is usually the case, the reduction in shock to synchronous machines may in a given case be most important, and may in itself not only justify, but dictate, that single-pole reclosing be chosen if parallel tie lines are to be avoided. Figure 2 has been prepared to illustrate this point. Power-angle curves are drawn for the simple system shown on the figure, for single line-to-ground faults on the transmission line, cleared and reclosed with both gang-operated and single-pole operated breakers. Note that in the case employing gang-operated breakers the internal voltage of the generator advances to an angle of 82 deg with respect to the receiving system, which is assumed to be of infinite inertia. At this angle between sending- and receiving-end generated voltages reclosure occurs, and neglecting losses, the load on the generator changes instantly from substantially zero to a high value near the peak of the power angle curve. The shock to the generator shaft, couplings, etc., is proportional to the distance bracketed and labeled (1), and can, in the case of certain machines, be of a magnitude to be dangerous mechanically. Note further that there is no question of the ability of the system to maintain stability, since the maximum swing is to an angle of 127 deg, whereas a swing to 155 deg could be tolerated before stability becomes critical.

The other portion of Fig. 2 shows the same fault cleared and reclosed with single-pole operated breakers. During the fault considerable power can be transmitted over the sound phases, and the generator internal voltage therefore swings ahead of receiver voltage slowly. (The difference between prime mover input and power output, or power available for acceleration, is small.) Reclosure takes place at an angle of 45 deg, and the sudden change in generator loading is proportional to the distance bracketed and labeled (2). A comparison of the distances (1) and (2) in Fig. 2 indicates the tremendous difference in sudden load, or shock, which the generator mechanical parts must withstand. For any particular practical case where this shock loading may be investigated, actual quantitative relations are calculated which must be within the safe stress limits of the synchronous generators. The result of such a calculation may dictate single-pole switching, regardless of transient power limits.

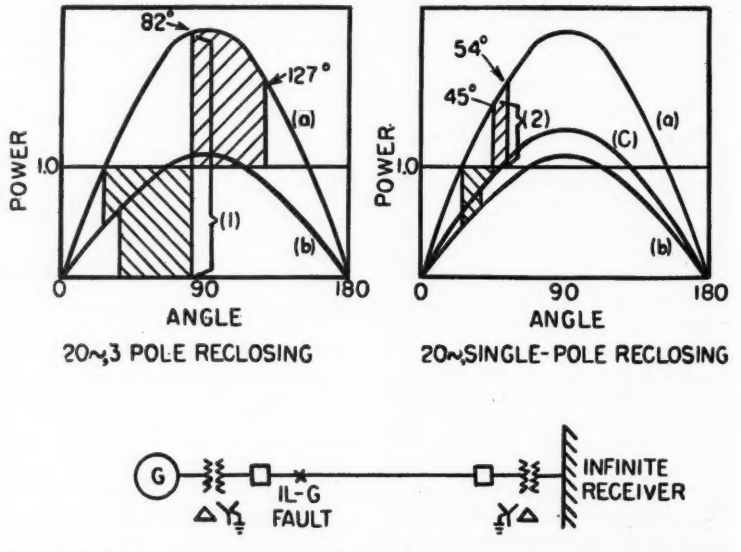


Fig. 2. Comparison on a simple system of the angle at which reclosure occurs and shock to generator, using three-pole and single-pole reclosing.

(a) Power-angle curve before the fault
(b) Power-angle curve during IL-G fault
(c) Power-angle curve during isolation of faulted phase

If single-pole reclosing is used for the foregoing reason, it is then more important than ever to insure most faults being single line-to-ground in nature. For multi-phase faults the relaying must be arranged to open all poles and lock out without any attempt at reclosure, otherwise damage to machinery would be risked. On new lines, the design can be so coordinated that line-to-ground flashover will be much lower than phase-to-phase flashover, and most faults will therefore involve only one phase and ground. Low tower-footing resistance will further diminish the number of phase faults. In some cases, opening and reclosure of two-phases during phase-to-phase and double line-to-ground faults may be permissible. Lockout without an attempt at reclosure is still necessary on three-phase faults.

Single-Pole Reclosing Applied

The first application of high-speed single-pole reclosing was briefly mentioned in the introduction. Since then, four newly built 132 kv circuits on the Public Service Co. of Indiana, Inc., system have been designed for single-pole operation. These four circuits form a portion of the important North-South interconnection which links the Chicago and Northern Indiana industrial area to Louisville and ultimately the T.V.A.

The relaying and reclosing on the initial Lenore to New Castle installation is such that single-pole tripping and reclosing in a maximum of 35 cycles takes place for all single-phase faults, and opening without an attempt at reclosure takes place for all multi-phase faults. System fault tests prove that reclosure is consistently faster than 30 cycles. On the four new installations the relaying and reclosing is arranged for single-pole operation in not more than 35 cycles on single-phase faults, and also for gang-operation and reclosure on all types of multi-phase faults. Eight cycle breakers and carrier-current relaying are employed. The phase relaying is of the conventional type, and the ground relaying accomplishes phase discrimination on single line-to-ground faults by comparing the phase-angle relation of the sequence components of the fault current. During single line-to-ground faults, the negative- and zero-sequence currents for the faulted phase are in phase, but the negative- and zero-sequence components for the unfaulted phases differ in angle by 120 deg. These sequence currents for each phase are segregated by suitable filters and applied to one element of a three-element relay. Thus, when phase B is faulted to ground, the B element of the relay receives sequence currents that are in phase, and this element closes contacts to initiate tripping of B pole of the breaker. In the A and C elements the sequence currents are 120 deg out of phase, closing torque is not present and tripping is not initiated. All installations reopen and lock out if the first attempt at reclosure is not satisfactory.

Table I. Comparative transient power limits calculated for Dresser to La Fayette 132 kv line with different types of reclosing, 8-cycle breakers and carrier-current relaying

Item	Type Of Fault	Reclosing Time	Type Of Reclosing	Comparative Transient Power Limits: Megawatts Delivered	Comparative Transient Power Limits: Per Cent
1	Single Line-To-Ground	35	Gang	100	100
2		20		127	127
3		35	Single Pole	156	156
4		20		159	159
5	Double Line-To-Ground	35	Gang	98	100
6		20		125	128
7	THREE-Phase	35	Gang	94	100
8		20		120	128

The new line section extending from Dresser to La Fayette is the longest single section upon which high-speed, single-pole reclosing has thus far been applied. The distance is nearly 100 miles and the normal system voltage is, of course, 132 kv. It has been pointed out previously that current continues to flow in the fault arc even after the faulted phase has been isolated at both ends of the line. This continuance of current flow is caused by the capacitive coupling with the two sound and energized phases, which coupling maintains a potential of about 15 per cent of normal line-to-neutral potential on the faulted conductor after it is isolated. On the Dresser to La Fayette line there will be 5 to 6 amp in the arc during faulty-phase de-energization, and no difficulty is anticipated in the ability of this arc to be self-extinguishing in the de-energized time allowed.

Because of this current it has been suggested that longer de-ionization time be allowed for single-pole over three-pole reclosing. Because of the paucity of data available, this point remains controversial. It is believed that no extra de-ionizing time need be provided on usual line sections of 50 to 100 miles or so. On the few sections at very high voltages where lengths greatly in excess of this are encountered, extra time or even auxiliary devices to neutralize the capacitive coupling could be considered. A recent test of opening a ground fault by single-pole operation, performed on an exceedingly long line section at very high voltage, showed the isolated arc to be self-extinguishing in several cycles. The arc, during single-phase isolation, carried a current several times the 5 or 6 amp expected for similar operation on the Dresser-La Fayette line. While it is recognized that an isolated test of this nature is only fragmentary evidence of expected performance, it is nevertheless an indication that the ability of arcs to be self-extinguishing under single-pole switching conditions may not be as critical as anticipated by some. The authors continue to hope that more comprehensive information on arc de-ionizing time will be made available through field tests.

Since the Dresser to La Fayette line is the longest section employing high-speed single-pole reclosing thus far installed, and since it is one link in the important interconnection described, it is of interest to investigate the transient power limits obtained with the reclosing scheme applied. Table I shows a summary of the results of calculations made to determine comparative transient power limits employing three-pole and single-pole reclosing, with speeds of reclosure of both 35 and 20 cycles. The large increase in stability limits gained with single-pole switching compares closely with calculations performed on other lines and summarized in previous works (1, 3). The 35-cycle, single-pole reclosing actually installed renders a transient power limit of 156 megawatts, which figure is sufficiently high to meet all expected

(*Continued on page* 138)

Don't Wince at the Math—Learn to Read It!

Part II

Last month,[1] the authors gave you a nice easy introduction to the language of mathematics, to the symbols used and what they stand for; they also told you about graphs, what they mean and how they are made. There was nothing hard or mysterious about it. Now, hold tight, and don't get excited; here come a few integral signs and "j"s. The "j"s are used in so-called complex numbers but don't let that floor you. Complex numbers are really very simple and they should be taught in fourth grade—you have probably used them for years without knowing it. The "j" is supposed to be an imaginary number but that's "the bunk", they are no more imaginary than your grandmother

By W. C. Sealey and Mrs. B. M. Sealey*

**Allis-Chalmers Manufacturing Company, Milwaukee, Wis.*

THE FIRST HALF of this article, which appeared in the May issue, was devoted to an explanation of symbols and graphs for readers of mathematics in technical literature. The part which follows, after introducing other symbols and graphical forms, concludes with a

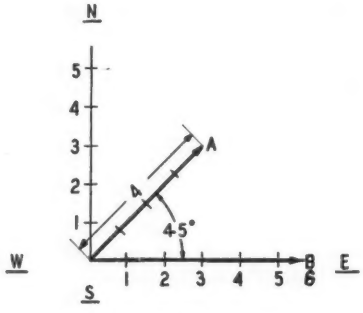


Fig. 4a. Velocity vectors

demonstration "reading" of a passage of mathematics.

The expression $\sqrt{-1}$ is called an imaginary number, because no existing number can express the value of the square root of a negative number $(-1 \times -1 = 1)$. Usually, the form $\sqrt{-1}$ is designated simply as "i," or, where "i" would conflict with other letter symbols, as "j". An expression such as $4 + 6i$ is known as a complex number, a number consisting of two parts. One part is the imaginary number 6i and the other part is the real number 4. In electrical work, since the letter i stands for current, the letter j is used to avoid confusion; and complex numbers are written in the form $4 + j6$.

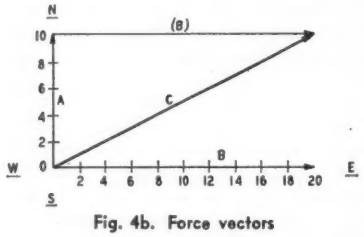


Fig. 4b. Force vectors

Complex numbers are used with vectors, a form of graphical representation (physical pictures of ideas). A vector is a line of definite length and direction. The line's length indicates the numerical value of a quantity. The line's direction shows the direction of action, or the timing, or some other characteristic of the quantity. The fact that a man walks northeast at 4 miles an hour can be shown by a vector (a single line) 4 units long pointing northeast, as on a map. (Line A of Fig. 4a.) The fact that another man runs east at 6 miles an hour can be shown by another line 6 units long pointing east. (Line B of Fig. 4a.)

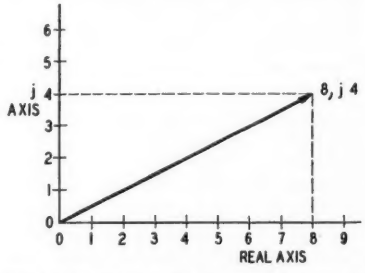


Fig. 4c. Complex numbers applied to vectors

Vectors are used to give physical pictures of many types of quantities, including forces, electric currents and voltages. The following is an example of force vectors. Suppose that one force of 10 lb is acting on a body to move it toward the north and that another force of 20 lb is acting to move it toward the east. These two forces can be depicted by two vectors (A and B, Fig. 4b). The single force and direction resulting from the combined effect of the two forces can be represented by a third vector (Vector C, Fig. 4b). Vector C represents the sum of Vector A and Vector B. The start of one vector having been placed at the end of the other, the sum vector is drawn connecting their free ends. The numerical value for the sum of two vectors can be determined by thus drawing and measuring a third vector representing their sum. However, a far more accurate method makes use of complex numbers.

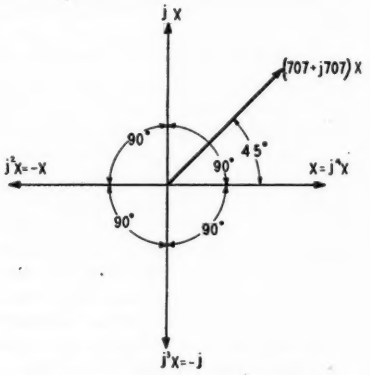


Fig. 4d. Rotation of vectors by j

The clearest conception of complex numbers can be obtained from a graph. In representing complex numbers on a graph, the j's always are plotted along the vertical axis and the real numbers always are plotted along the horizontal axis.

[1]Page 91, May issue.

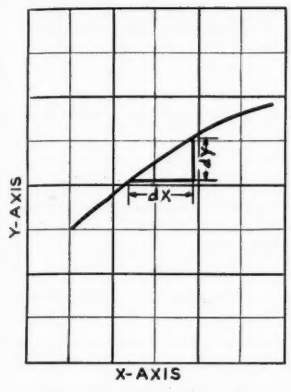


Fig. 5. Graph of dx and dy to greatly enlarged scale

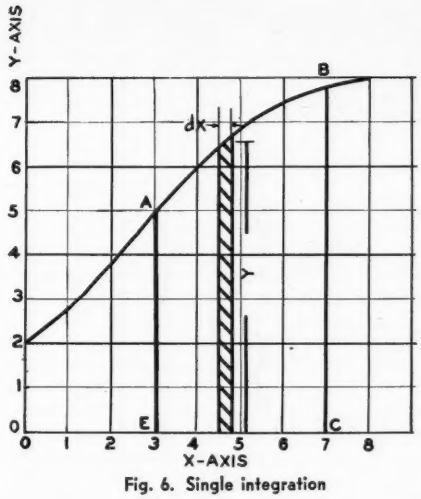


Fig. 6. Single integration

For example, in the complex number $8 + j4$, the real number 8 is plotted along the horizontal axis, the imaginary number j4 along the vertical axis. The graph of $8 + j4$ is a single line of definite length from the original to the point (8, j4). In Fig. 4c, it is the line from zero to point A. It is possible, by plotting any complex number in this manner, to obtain a single line which will represent it.

Finding the numerical value of a given vector involves finding the complex number which that vector, a single line, represents by its position and length, the reverse of the process just explained. Thinking of the given vector as a line on a graph, what two plotted values, one real and one imaginary, mark the end of that line? For Vector C of Fig. 4b, since the vertical axis always is assigned the label j, the values are 20 and j10, or the complex number $20 + j10$. Using this complex number, the mathematician can calculate very accurately the length of Vector C in real numbers.

The position of vectors often is defined by the angle between them. In representing alternating-current voltages, the time of one alternating current cycle, a cycle of 360 electrical degrees, is said to be equal to 360 geometrical degrees of the circle. The length of alternating-current voltage vectors indicates their numerical value. The positions of the vectors represents the relative times when the voltages reach maximum values. Two voltages reaching their maximum values $\frac{1}{8}$ of a cycle apart are said to be 45 electrical degrees apart ($\frac{1}{8}$ of 360). The vectors for two such voltages will be 45 degrees apart, also (like Vectors A and B, Fig. 4a). These vectors may be added, as described for forces, by drawing and scaling a vector representing their sum or by the use of imaginary numbers.

Multiplying a number by j causes the vector of that number to rotate through a 90 deg angle. In Fig. 4d, the real number X, shown as a vector on the horizontal axis, becomes the imaginary number jX. Because it is an imaginary number, jX is shown as a vector on the vertical axis. Thus X, being multiplied by j, rotates through 90 deg to a new position as jX.

Multiplying again by j causes the rotation of jX through 90 deg to a new position as j^2X. When j^2 occurs in calculations with imaginary numbers, it may be replaced by -1, since $\sqrt{-1} \times \sqrt{-1} = -1$. The number j^2X, therefore, is $-X$, the negative counterpart of $+X$ on the horizontal axis.[2]

The full rotation through four 90 deg angles back to X is shown in Fig. 4d. By choosing any factor containing j, a complex number for example, a similar rotation through other angles can be secured.

Functions

Among the general symbols used in mathematics is the symbol "f(X)," which is read in words as "a function of X," and stands for "a mathematical expression containing the symbol X." The general expression f(X) is used as a temporary marker to mark the place where a particular expression, now unrevealed may appear, some definite expression like $\frac{1}{1+X}$, or sin X, or $X^2 + 2X - 5$, or $\frac{X+2}{X2+4\sin X}$.

All that is now being said about the particular expression, however, is that it contains the symbol X.

Let us suppose that a writer begins with the equation $y = f(X)$. This means that he is expressing the relation between y and x in general terms, because he is not yet ready to state it in particular terms.

General: $y = f(X)$.

As the writer proceeds with his manipulations, they reveal the particular expression that may be put into the place of the general one.

Particular: $y = X^2 + 10X - 6$

The symbol $\triangle X$, read "delta X," (also $\triangle Y$, $\triangle t$, $\triangle h$, etc.) stands for "a small increase in the value of X." The symbol dx, read "dee x," (not d multiplied by x)

[2]Since multiplying a vector by j, twice, rotates that vector through half a circle (180 deg) it should be obvious that multiplying the vector by j only once, rotates the vector only half as much or through 90 deg. Thus, since j is the symbol for $\sqrt{-1}$, multiplication by $\sqrt{-1}$ merely implies rotation through 90 deg.—Editor.

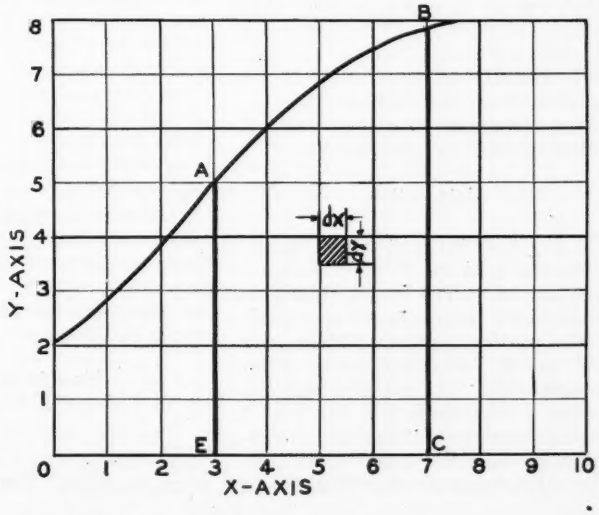


Fig. 7. Double integration

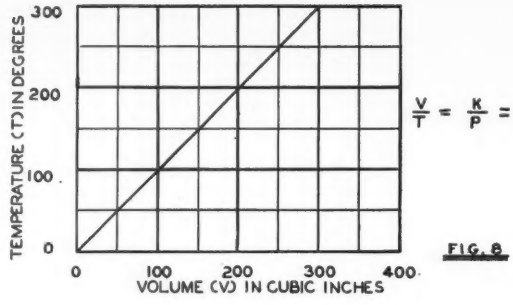


FIG. 8

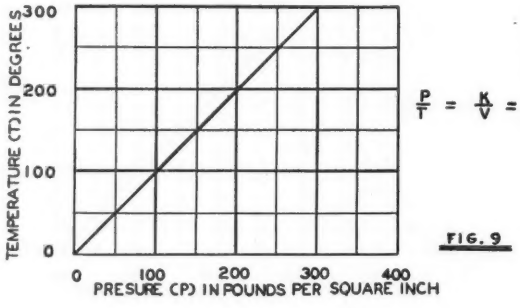


FIG. 9

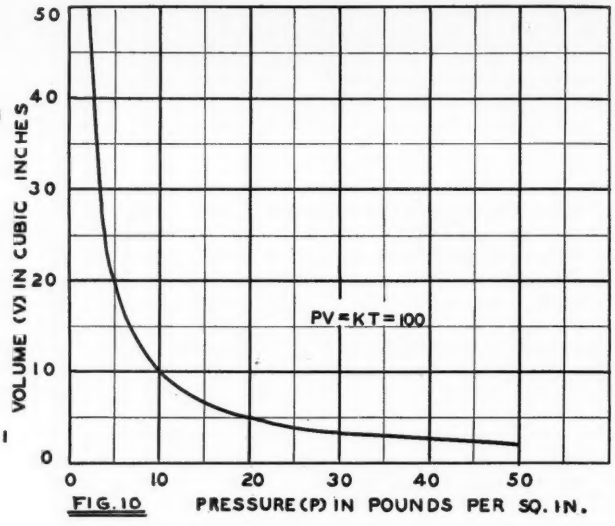


FIG. 10

Fig. 8. Volume-temperature graph
Fig. 9. Pressure-temperature graph
Fig. 10. Pressure-volume graph

stands for "an infinitesimal increase in the value of x." The difference between dx and delta x is a matter of size, delta x being small but finite, while dx is infinitesimally small ($\triangle X > dx$).

On a graph, drawn to a greatly exaggerated scale in order to show it, dx is an infinitesimal distance parallel to the X-axis, dy an infinitesimal distance parallel to the Y-axis. (Fig. 5.) The expression $\frac{dy}{dx}$ indicates the rate of change in the distance dy with respect to the distance dx, or what is known as the "slope" or steepness of this part of the curve. For example, the statement $\frac{dy}{dx} = \frac{1}{2}$ shows that dy is increasing only one unit to dx's two, or half as fast, indicating that here the "slope" of the curve is not very steep, since the horizontal distance is lengthening more rapidly than the vertical distance. (The baseball is going forward faster than it is going upward.)

Integration

$\int$, the integral sign, means "the integration of" or "the summation of." The words "integration" and "summation" both mean "the putting together of a number of parts" and are used interchangeably. The integral sign assigns a task similar to the job of tying together matchsticks in bundles so that the matchsticks may lose their separate identities and be used henceforth as bundles. Any type of units may be integrated or summated, such as numbers, areas, distances, drops of water, bushels of wheat.

Let us illustrate the process of integration graphically in order to get a physical picture of it. (Fig. 6.)

$\int_3^7 y\,dx$ means the integration of all the small areas named $y \cdot dx$ that are included in the larger area named abcea, that large area lying between the curve and the X-axis, and the $x = 3$ and $x = 7$ lines.

$\int_{x=3}^{x=B} \int_{y=0}^{y=f(X)} dx \cdot dy$ (known as double integration) means the integration of all the small areas namely $dx \cdot dy$ (in Fig. 7) that are included in the larger area named abcea, that large area which lies between the curve and the X-axis and the $x = 3$ and $x = 7$ lines. Notice that a number of the small areas $dx \cdot dy$, if stacked in a vertical column, would form the area $y \cdot dx$. Hence double integration is in a sense the integration of integrated parts.

Integrations such as these that have been pictured graphically can be performed by counting the areas on a graph or by calculations, rules and formulas for which are given in the calculus.

How to Read a Passage of Mathematics

The demonstration that follows shows how to read a sample passage of mathematics. First, the passage is given in its entirety, including three illustrative graphs (Figs. 8, 9 and 10) just as it might appear in a technical article, and then the process of reading it is explained. After the translation of symbols into words has been made, two ways are suggested for arriving at a clear understanding of the meaning of the translated words. Because there is no better way to understand an idea than to get a physical picture of it, the use of the graphs is given first, before the analytical method. An illustration showing how the final equation may be put to practical use ends the discussion of this sample passage of mathematics.

PART (A)

The relations between the pressure, volume and temperature of a gas were discovered by different observers at widely separated times. The known relations for a fixed quantity of gas are:

Boyle's law: $\frac{P_1}{P} = \frac{V}{V_1}$ (when temperature remains constant)

Charles' law: $\frac{P_1}{P} = \frac{T_1}{T}$ (when volume remains constant)

Gay-Lussac's law: $\frac{V_1}{V} = \frac{T_1}{T}$ (when pressure remains constant)

In these equations P_1, V_1, and T_1 are, respectively, the initial pressure, volume and absolute temperature; P, V, and T are, respectively, the final pressure, volume and absolute temperature. It would be convenient to have a single expression for the relations between pressure, volume and temperature for a fixed weight of gas.

PART (B)

Such an expression may be derived by combining the discovered relations:

$$PV = P_1V_1$$
$$PT_1 = P_1T$$
$$VT_1 = V_1T$$
$$P^2V^2T_1^2 = P_1^2V_1^2T^2$$
$$PVT_1 = P_1V_1T$$
$$\frac{PV}{T} = \frac{P_1V_1}{T_1}$$

PART (C)

$$\frac{PV}{T} = K \text{ (a constant)}$$

In Part (A), the introductory statement, the writer tells what symbols will be used for the quantities involved, what the known relations between those quantities are and what he wishes to find. Statement of the known relations in words:

Boyle's law: The initial pressure divided by the final pressure is equal to the final volume divided by the initial volume.

Charles' law: The initial pressure divided by the final pressure is equal to the initial temperature divided by the final temperature.

Gay-Lussac's law: The initial volume divided by the final volume is equal to the initial temperature divided by the final temperature. Statement of what is to be found: "a single expression giving the relation between pressure, volume and temperature for a fixed weight of gas."

In Part (B), the author manipulates the given expressions according to mathematical laws.

Part (C) is the final equation giving the answer to the problem: $\frac{PV}{T} = K$. Statement of the final solution in words:

> Pressure multiplied by volume and divided by temperature is equal to a constant number.

Value of Graphs

The three graphs that are a part of this passage of mathematics give physical pictures of the relative values expressed in the final equation. Since K is a constant number and never changes (for a fixed weight of gas), the only changes to be pictured are those in pressure, volume or temperature. Each graph shows the changes in two of these values, while the other is assumed to remain constant. The meaning of each graph can be obtained by applying the method previously given:

Figure 8: This graph shows volume in cubic inches and temperature in degrees C.

The X-axis is numbered from left to right, and the Y-axis from the bottom to the top.

Tracing along the curve in the direction of increasing volume, it may be noted that the temperature increases simultaneously.

Following the direction of decreasing volume, it may be noted that the temperature decreases simultaneously.

Figure 9: This graph shows pressure in pounds per square inch and temperature in degrees C.

The X-axis is numbered from left to right and the Y-axis from bottom to top.

Tracing along the curve in the direction of increasing pressure, it may be noted that the temperature also increases.

Tracing the direction of decreasing pressure, it may be noted that the temperature also decreases.

Figure 10: This graph shows pressure in pounds per square inch and volume in cubic inches.

The X-axis is numbered from left to right, and the Y-axis from bottom to top.

Tracing along the curve in the direction of increasing pressure, the volume decreases rapidly at first, then decreases at a slower rate, until, at the right side of the graph, the volume decreases very slowly.

Tracing the direction of decreasing pressure, the volume increases slowly at first, then more rapidly, until, at the left side of the graph, the volume increases very rapidly.

An analytical interpretation of the final equation, $\frac{PV}{T} = K$, is based on the fact that any equation represents two groups of elements that are in equilibrium. The two sides of the equation $\frac{PV}{T}$ and K, must, because they are said to be equal, be kept in balance, like the sides of a scale. K, being a constant, does not change, but P, V and T may change. If the pressure (P) increases, either the temperature (T) must increase or the volume (V) must decrease in order to restore balance, or there must be an adjustment in which both change, with, for example, the volume (V) decreasing and the temperature (T) increasing.

The final equation may be used as a formula in determining the numerical value of either P, V, T or K when the numerical values of the others are known.

Example 1: Given P, V and T, find K.

If it is known that, for a fixed weight of gas,

$P = 30$ lb per sq in.
$V = 200$ cu in.
$T = 300$ deg (Absolute)

then, substituting these values in the equation,

$$K = \frac{PV}{T} = \frac{30 \times 200}{300} = 20$$

and, therefore, $K = 20$.

Example 2: Given P, V and K, find T.

If, for the same weight of gas as in Example 1, the pressure and volume change so that:

$P = 60$ lb per sq in.
$V = 150$ cu in.
$K = 20$

then, substituting these values in the equation, $\frac{PV}{T} = K$,

$$\frac{60 \times 150}{T} = 20$$

multiplying both sides by T:

$$T\left(\frac{60 \times 150}{T}\right) = 20T:$$
$$20T = 9000$$
$$T = 450 \text{ deg (Absolute)}.$$

As a reader of technical literature, you can form the habit of reading the passages of mathematics by dealing with them always in this same way. First, you will read the beginning and ending equations in words. Then, if their meaning is not immediately clear, you will make it plainer by means of graphs. When the author of the article provides graphs to illustrate his findings, you will trace out the meaning of each graph. If the author does not give graphs, you may draw rough graphs of your own. As you know, two or three repetitions of a course of action make it a habit, an action which from then on is performed automatically. After a few repetitions of mathematical reading, you will find yourself doing it mechanically, and quite painlessly getting the meaning of mathematical passages in technical articles.

In reading mathematics in this way, do not let the fact that you may not have had much formal training in mathematics bother you. True, in most text books nothing is ever said about calculus until the subjects of algebra and trigonometry have been thoroughly covered but this does not mean that you cannot understand the purpose of the calculus.

Corrosion of Condenser Tubes by Ammonia

At the Edmond St. Plant of St. Joseph Railway, Light, Heat & Power Co. in St. Joseph, Mo., corrosion of tubes in a new condenser increased rapidly after 31 months of service . . . Very efficient condenser of special design by company's engineers to fit unusual conditions . . . Tube failures analyzed . . . Ammonia, at first not suspected, finally turned out to be the culprit . . . Relation between fatigue stress and corrosion . . . Various remedies suggested . . . Tubes of various types installed in May, 1940, in test section in condenser . . . Results in May, 1943, from test section . . . Further data now being collected on life of the various alloys

By Ernest B. Harrison — *Assistant Production Superintendent, St. Joseph Railway, Light, Heat & Power Co.*

ALTHOUGH STEAM produced in the boilers at the Edmond St. Plant of the St. Joseph Railway, Light, Heat & Power Co. has for many years contained ammonia up to 0.5 ppm (as NH_3) no serious corrosion of condenser tubes was discovered until 1939. Experience in this plant indicates that the rate of corrosion by ammonia is a function of condenser design, quantity of ammonia in the steam, kind of tube, and other minor factors.

In this particular case, design heads the list, for the reason that serious corrosion has occurred in only one of four condensers serving turbines that receive steam from the same steam header. Tubes affected only to a slight degree are in condensers of the Alberger Spiroflow or similar horizontal, two-pass type, in which the exhaust steam enters at the top and flows down through the tube bundle. Air offtakes are located about half way down the shell. The fourth condenser, in which serious corrosion has occurred, is of an entirely different type, as described briefly below.

In the following comments on the corrosion in this condenser, it is not intended to imply that the design of the condenser is faulty in respect to efficient condensing. In fact, it is the most efficient condenser in the plant.

History of the Condenser Design

Late in 1935, the St. Joseph company decided on the immediate installation of 10,000 kw of additional generating capacity to replace a block of purchased energy. Installation was a problem in that all floor space in the generating room was occupied by prime or standby units. Horizontal expansion of the building was impossible.

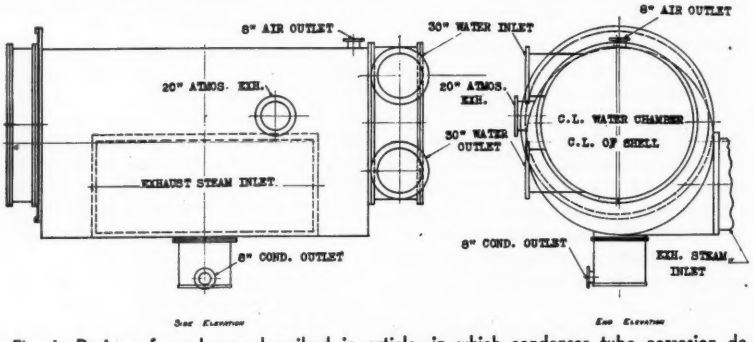


Fig. 1. Design of condenser described in article, in which condenser tube corrosion developed rapidly after 1939

The site selected was that occupied by an obsolete, compound reciprocating-engine-driven generator. To save time and prevent possible damage to adjacent equipment, the old engine foundation was utilized rather than start from bedrock for a new foundation. However, headroom did not permit a conventional horizontal condenser installation nor did floor space permit a vertical condenser.

A tentative design by our Engineering Department was approved by the manufacturer. This design was for a two-pass horizontal condenser to be located at right angles to the turbine shaft with its center line 16 ft 5 in. from the center line of the turbine exhaust and with the top of the condenser shell 3 ft below the turbine base.

Description of Condenser

The steam inlet was located on the lower right side, as shown in Fig. 1, and connected to the turbine exhaust with a rectangular neck. Exhaust steam from this connection is admitted to an annular space within the shell and surrounding the tube nest. The flow is radially upward toward the air offtake channels.

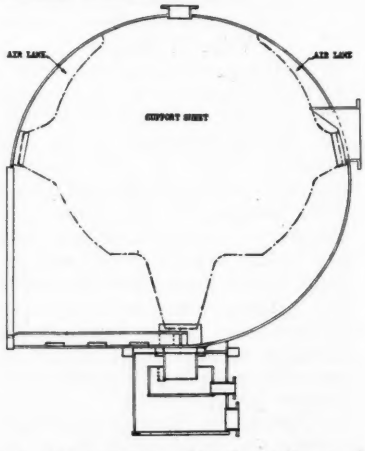


Fig. 2. Cross-section through condenser of Fig. 1 showing support sheet arrangement

Four support plates, as shown in Figs. 2 and 3, divide the upper part of the steam zone into five compartments, which are connected only through the air removal lanes outside the tube bundle. One 8-in. air offtake connection is provided in the top of the shell adjacent to the entering end tube sheet. Gases and vapor pass from the last four compartments through a narrow opening—see right hand section of Fig. 3—into the air offtake channels and then toward the front or entering end of the condenser. From the air offtake channel the gases and vapors flow back into the second half (a) of the first zone, then under an auxiliary baffle and out the 8-in. connection. The auxiliary baffle is eight tubes deep by thirty wide.

The condenser was tubed with arsenical copper, rolled in at both ends. Tube sheets are of Muntz metal and the front head is of the floating type. Arsenical copper tubes were chosen for the new condenser because of previous trouble in the form of dezincification with low copper alloys.

This detailed description of the condenser is given because of its value in explaining the rapid corrosion rate.

Cooling Water and Makeup Conditions

Cooling water is pumped from the Missouri River. The intake is located a few hundred feet below the outlet of a large storm and sanitation sewer. Temperature of the river water has a range of 53 F (32 F to 85 F). In general, the nitrogen content of the river water at the intake is higher in the winter months because of a lower river stage.

Makeup water is supplied from wells either directly to the water softener or indirectly through turbine oil coolers, etc. This water contains varying amounts of ferrous bicarbonate and ammonia nitrogen averaging about 2.0 ppm as NH_3. The presence of iron is mentioned because it is a factor in the removal of ammonia from the makeup supply.

Makeup is treated in a hot process (215 F) lime-soda softener. Return condensate is heated to a maximum of 170 F in stage heaters and then to 215 F in open, direct-contact type feedwater heaters, which have been adapted for operating at 1.5 psi gage. Gases are discharged through vent condensers.

Location and Type of Tube Failures

The new turbine began operating in July, 1936. The condenser proved entirely satisfactory in condensing efficiency. The first tube failure was reported in October, 1938, twenty-seven months after beginning service. A few additional failures were reported in November, December and January. These were assumed to be caused by defects in the tubes. However, in February, 1939, failures increased at an alarming rate and then tubes were removed for inspection. Corrosion of a type new to this plant was found.

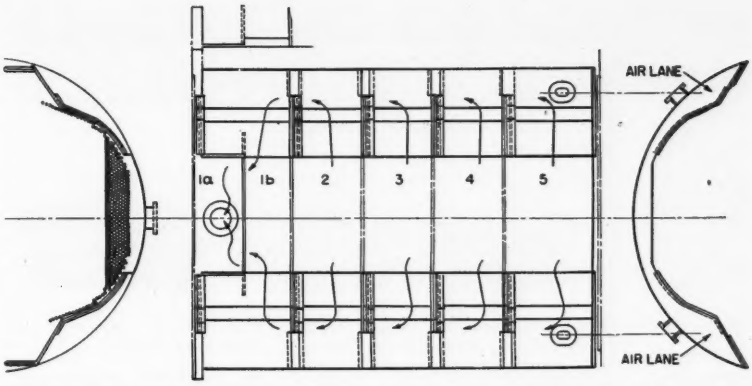


Fig. 3. Center—Plan of condenser showing arrangements of zones and normal gas flow. Left—Tube support sheet. Right—Tube bundle between support sheets

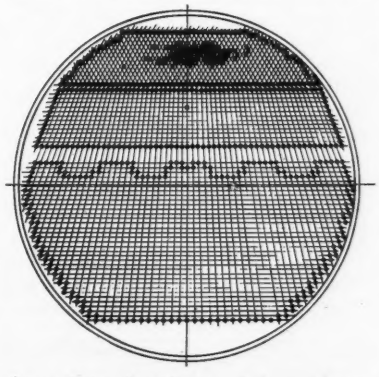


Fig. 4. Tube sheet layout of the condenser of Fig. 1

All corrosion was found to be on the steam side of the tubes and adjacent to the tube sheet. It appeared that a very corrosive fluid was flowing down the tube sheet and around the tubes. A deep ring was etched in the tube near the roll, and general corrosion extended back along the tubes for several inches. Figure 5 was sketched from a specimen that had not failed. Figures 6 and 7 are photographs of a tube that had failed. The flat section is the part of the tube that had been expanded in the tube sheet. The deep etching just inside the tube sheet is clearly shown.

Although severe corrosion was confined to the area adjacent to the tube sheet on the entering, or cold, end of the condenser, the same general type of corrosion was found on both sides of the support plates. The corrosion rate at the first support plate was only a fraction of that at the tube sheet. The rate decreased toward the reversing end of the condenser, being hardly no-

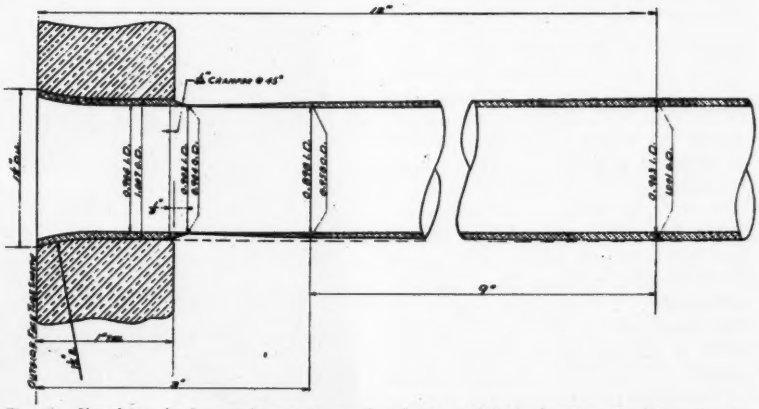


Fig. 5. Sketch made from tube specimen that had not failed, showing metal loss due to corrosion. In service July, 1936; removed February 10, 1940; active to time of removal. Tube location: 7th row from top—15th tube from right facing tube plate, inlet end of condenser

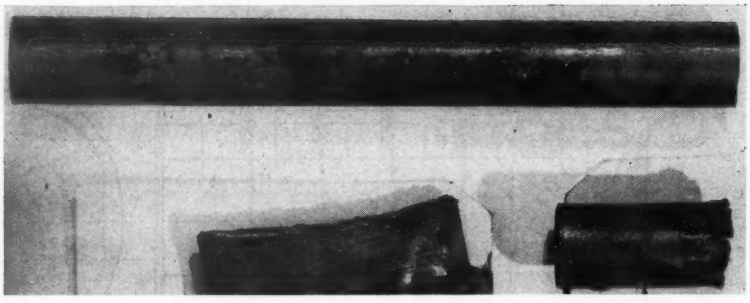


Fig. 6. Photograph of sections cut from first 12 in. of corroded tube. Flat section is part expanded in tube sheet. Note etching just inside tube sheet

ticeable at the reversing end tube sheet.

Ammonia Corrosion Not Suspected at First

That ammonia was in part or totally responsible for the corrosion was not discovered until considerable time was expended in testing and discussion. Because corrosion was limited not only to one condenser, but to a comparatively small area of that one, a mechanical reason for the failure was indicated. Moreover, the specimens removed for examination showed very little evidence of corrosion products.

Specimens were sent to various laboratories for chemical and physical examination. The following are excerpts from one laboratory report:

"The tubes were cut in two lengthwise to examine the interior surface. All specimens were in good condition, merely having a light copper oxide coating. . . . Specimen 25 in. long. First 25 in. of tube from fourth row down, fourteenth from right. This specimen was badly corroded over the outside and especially at the end. . . . From the appearance of specimens 2, 3, 4 and 5, one would believe that some corrosive agent was flowing down the tube sheet and both sides of the support plate, corroding a groove around the tubes as a rivulet formed around the tubes, and with a spreading action along the tubes from these points of greatest attack. . . . Microscopic examination of specimens cut from the corroded area of the tubes reveals that an intercrystalline action has been taking place. The grain boundaries are being progressively attacked. . . . The slight deposit on the inside of the tubes was removed with a careful acid treatment in order to eliminate contamination of corroded products on the outside portion. . . . Boiling in distilled water indicated that the corrosion products were only slightly soluble in water. In the water soluble portion we found: Sulphates—Nil; Chlorides—Very slight trace; Nitrates—Minute trace. . . . Now allowing the tubes to dry, the corrosion products were carefully removed and subjected to a complete analysis with the following results:

Organic and Volatile	3.00 per cent
Sulphates	Nil
Iron and Alumina	1.28 per cent
Nitrates	Minute trace
Zinc, Calcium, Magnesium, Manganese	Nil
Arsenic	Trace
Copper Oxide	89.20 per cent
Silica	0.72 per cent
	94.20 per cent

"No positive value for carbon dioxide was found, but it is believed that a very small amount or portion of the copper may have combined with CO_2 as a basic cupric carbonate. The blue-green tinge noted in the deposit may be the result of this compound. . . .

"We are inclined to believe this white flocculent material consists of a microscopic film of arsenious oxide which has been deposited out of the copper. Our analyses do not indicate the presence of any salts in the corrosion products. . . . The corroded portions of these tubes are very similar in appearance to those removed from another condenser some years ago, and which, it was found, were being deteriorated by the injection of ammonia vapors into the condenser. . . . No definite conclusions can be reached from an examination of these samples, and the other information at hand. . . ." (End of quotation from laboratory report.)

Check Made for Ammonia

The above reference to ammonia was the one definite lead realized from several laboratory investigations. Beginning in June, 1939, an intensive check was made throughout the steam-water cycle for ammonia and other corrosive agents. With the exception of carbon dioxide and ammonia, no corrosive agents were found. Preliminary tests for ammonia showed a concentration in steam of 0.2 to 0.3 ppm. Later in the year, as the makeup increased due to urban heating demands, the amount of ammonia increased. Most of the ammonia originates with the well water and is present as ammoniacal nitrogen. Some ammonia is introduced in the feedwater cycle by condenser leakage. This leakage contains both ammoniacal and organic nitrogen. Albuminoid nitrogen is converted to ammoniacal nitrogen after entering the boiler.

Tests for ammoniacal nitrogen in December, 1939, averaged as shown in the following table:

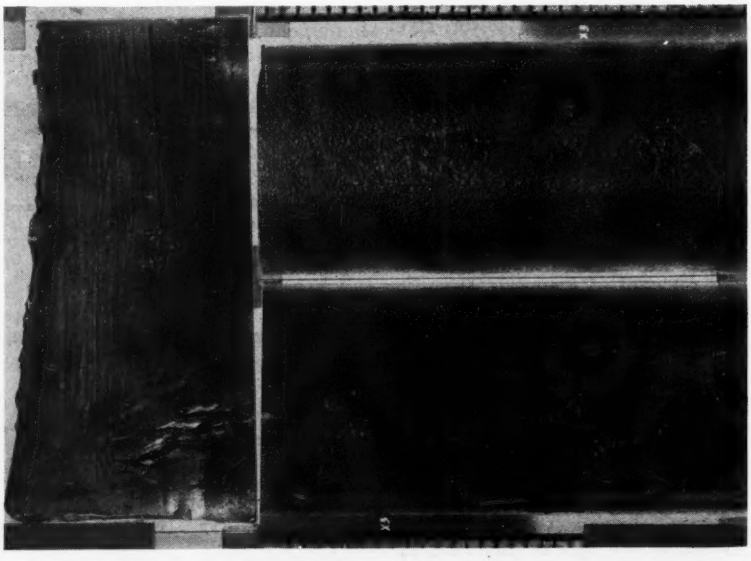


Fig. 7. Enlarged views of sections from first 12 in. of corroded tube

Well Water (Makeup)	1.8 ppm (as NH_3)
Treated Water	1.2 ppm (as NH_3)
Feedwater	1.0 ppm (as NH_3)
Throttle Steam	1.2 ppm (as NH_3)
Condensate A	1.2 ppm (as NH_3)
Condensate B	1.1 ppm (as NH_3)
Condensate C	0.7 ppm (as NH_3)

Condensate "A" was taken from condensers unaffected by ammonia, "B" from the affected condenser when drip from aftercooler was returned to condensate pump suction, and "C" from the same condenser when drip from aftercooler of jet air pump was being wasted to sewer.

Ammonia was also found in the vapor discharged from the steam jet air pump. However, no adequate method was devised for accurate quantitative tests.

Concentration of ammonia in the amount found did not account for the rate of corrosion. Neither did it account for corrosion being confined to this one condenser. In fact, some authorities expressed doubt that ammonia was the principal cause of tube failure.

Corrosion by Ammonia Explained

After a careful study of all facts we were able to formulate an explanation of corrosion that seemed very reasonable. The explanation was based on the fact that, in certain areas of the condenser, a concentration of ammonia or ammonium salts, approaching saturation, was possible.

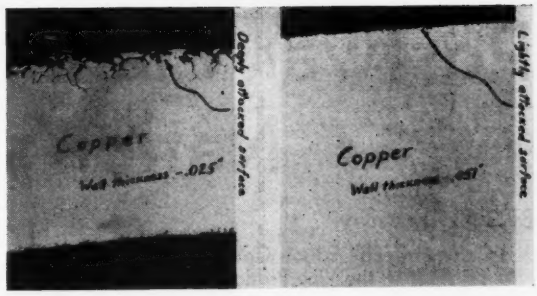


Fig. 8. Microscopic studies of cross-sections removed from corroded tube. Left—2 in. from tube sheet. Right—12 in. from tube sheet

In the winter months, steam is extracted from the turbine at three pressures for feedwater and urban heating. Also, in the winter months, the temperature of condensing water did average about 40 F, although the condenser was designed to maintain a vacuum of 28.5 in. Hg (abs) when supplied with 80 F condensing water. Better vacuum, plus the extraction feature, resulted in a condenser loading of 65 per cent or so of maximum. Consequently, the second pass or lower tubes do most of the work while the first pass or upper tubes in each section (see Figs. 1 and 4) are comparatively dry. The small amount of vapor condensed on the top tubes is cooled below condensing temperature and, being in an ammonia-rich atmosphere, becomes highly saturated with that gas. Since carbon dioxide is also present, it is probable that the two gases combine as ammonium carbonate.

The small quantity of ammonia-saturated condensate flows down through the condenser and mingles with warmer condensate. Part of the ammonia (and oxygen) is then reflashed and the balance passes on to the hotwell.

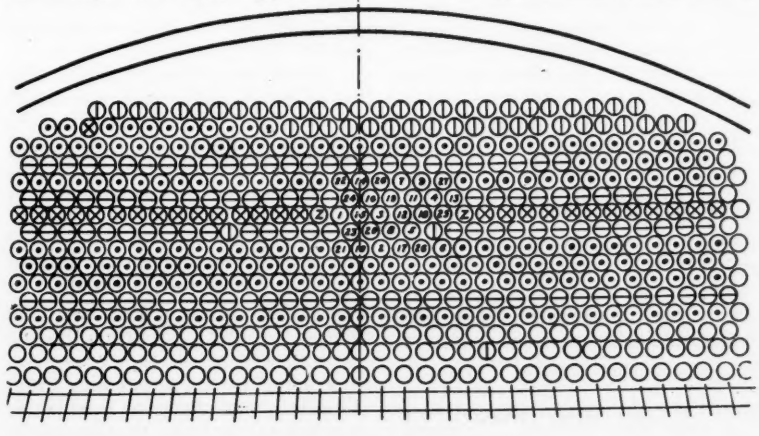
Leaving zones 2, 3, 4 and 5—see Fig. 3—the remaining gases and vapor pass out into the air offtake lane and at 1-b are drawn back into the tube bundle, pass under the auxiliary baffle and flow toward the 8-in. air offtake. The zone just under the 8-in. connection is the coldest in the condenser. The tube sheet and tubes in this area can approach a temperature of 32 F. The vapor and gases before contacting these tubes and the tube sheet are at a minimum of 60 F.

Because of this temperature difference, more vapor is condensed and becomes highly saturated with ammonia and carbon dioxide. Apparently condensation is greater on the tube sheet; this accounts for the deeply corroded ring around the tubes. As in the last four zones, this highly-saturated liquid is diluted as it flows down into the more active condensing area. Consequently, the rate of corrosion decreases below the air-cooling section.

That ammonia is the principal corroding agent is emphasized by the absence of corrosion products. Ammonia reacting with copper produces a highly-soluble cupric-ammonium compound which washes away as formed.

It is probable that stress fatigue is a contributing factor. This condenser is not equipped with circulating-water inlet strainers. A considerable amount of trash gets through the ¼ mesh traveling screens. Small twigs, etc., lodge at the tube inlets, causing frequent outages for condenser cleaning. Temperature changes in the condenser, due to these outages, could account for unusual tube stress. The first 10 minutes of each start-

(*Continued on Page* 140)



LEGEND:

- 220-Arsenical Copper
- 123-Arsenical Copper
- 53-Arsenical Copper
- 30-Admiralty Metal
- 2-Zinc Test Rod Points
- Arsenical Copper - Original, all tubes outside the section shown are of this type; 2,598 remaining in service.

TEST SECTION:

Tubes Nos. 1-2	Arsenical Copper
3-7	Phosphorized Admiralty
8-12	Arsenical Copper
13-17	Arsenical Copper
18-22	Antimonial Admiralty
23-28	Stainless Steel

Fig. 9. In May, 1940, 442 tubes were removed and new tubes installed in zone of severe corrosion as indicated

Postwar Planning of the Nation's Power Supply*

By Alex D. Bailey

Commonwealth Edison Co., Chicago, Ill.
Assistant to the Vice President

Industry planning peace time work . . . Pent-up savings a factor in postwar economy . . . Reduced reserve power capacity will need building up . . . New uses for electric service . . . Utilities loads dependent on manufacturers

WE HAVE climbed the hill to the point of maximum war production. War industries are using over 40 per cent of the output of all electric utilities, both privately and publicly owned, and in addition are supplying an appreciable amount of power for their own use, particularly where steam for processing is required. With the end of the war approaching in the not too far distant future, and recognizing conditions as they are, the electric utilities must now look forward to the years to come when this war activity will cease and when industry and civilian life itself will get back to a normal peace time basis.

Forward planning is not new to industry, particularly the utilities, but while plans for the future are difficult to make very far ahead even in normal times and with normal uncertainties, the war has multiplied these unknown factors many fold both as to the number and quality. Industry generally is planning and attempting to get back to peace time work as quickly as possible and to start with its conversion programs at as early a date as war conditions will permit.

It is evident that if we are to maintain our economic position in the world and in world trade, and if we are to continue to raise our standard of living, the output of the industrial worker must be increased many times above our prewar levels, and this can only be accomplished by the use of more machinery and more power. In the 20 yr from 1919 and 1939, the horsepower per worker in factories practically doubled. The war has given a tremendous impetus to this increase of power and output per individual. The index of industrial production has risen from about 130 to 250 from July, 1940, to 1944; while the number of workers in industry has increased only from 28.6 million to 32.7 million, according to the estimates of the Bureau of Labor Statistics and the War Manpower Commission. All this has been done in spite of the fact that the cream of our productive manhood has gone into the armed services and many people not previously employed such as boys, girls, and housewives have been substituted for them in industry.

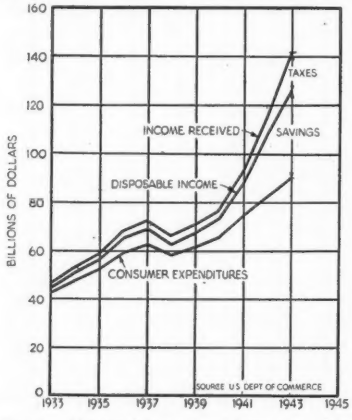


Fig. 1. National income and savings of individuals

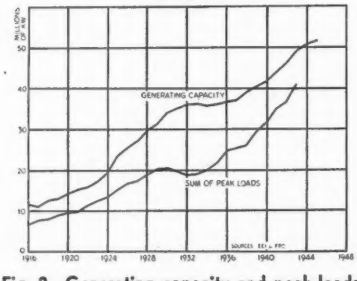


Fig. 2. Generating capacity and peak loads of all electric power plants contributing to the public supply

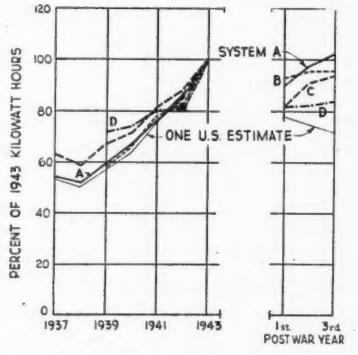


Fig. 3. Kilowatthour output of typical electric power systems in relation to 1943 data

This trend in the increased use of power—and this means electricity purchased from the utilities, is sure to continue.

In World War I the war expenditures were less than one-third of the national income, whereas they are now approaching 60 per cent. It may be expected, therefore, that the problems of reconversion after this war will be much greater than the problems after the last, and the effect of the conversion on the electrical power industry will be very much greater when we consider that in World War I industry was purchasing less than one-third of its power, whereas in the present war it is purchasing nearly 70 per cent, and is consuming over 40 per cent of the output of the electric utilities. We hope that the difficulties and problems of conversion will not be in direct proportion to the changed conditions. It is reassuring, however, to remember that at the conclusion of World War I there was no period of recession. A boom period followed which increased the national income from 57 billion dollars in 1918, to 68 billion dollars in 1920, with a corresponding improvement in business generally which included load for the utilities.

During the war the workers of the nation have not been able to purchase those things which they would like to own and have the money to buy; consequently the pent-up savings of this group are increasing at an astonishing rate. This is shown in Fig. 1 which is a chart taken from the figures of the Department of Commerce.

Reserve Capacity

At the beginning of the war the electric utilities were in a fortunate position due to their forward looking programs. In anticipation of increasing loads they had increased their reserve in generating capacity until in individual companies this amounted to 30 per cent. There was also ample reserve

*Abstract of paper presented at the Midwest Power Conference.

capacity in transmission and distribution equipment. This reserve made it possible for the utilities to take on the additional load of war industries with a relatively small increase in generating capacity and transmission and distribution equipment. This reserve kept them out of the manufacturers' shops when these were needed for the production of war materials. The extension of daylight saving time, known as "war time," throughout the year also reduced the peak load of the utilities by an amount variously estimated from 800,000 to 1,500,000 kw, and this amount of capacity went into the utility companies' reserve where it was immediately available for war industries. It is estimated that this difference in time made a difference of at least 80,000 kw in the winter peak load of the utilities in the Chicago area alone. At the end of the war the utilities, therefore, will find themselves with reduced reserves, a threat of the return of standard time in the winter months, which will use up a considerable part of that reserve, and a very uncertain outlook as to what will happen to their industrial load. Electric utilities are not like other industries which can delay deliveries when their plants are overloaded; the utility must deliver instantly when the demand is made and continue to deliver so long as the demand lasts.

Figure 2 shows the relation of installed capacity in all electric power plants, contributing to the public supply in the United States, to maximum demand during World War I, and up to the present time. In the period from 1916 to 1943 the sum of the maximum loads increased from 6.7 million to 41 million kw, while the total capacity reached 49 million kw. It will be noted that the excess reserve capacity resulting from building programs in the late 1920's and the depression of the 1930's was partially absorbed by 1939, and since that date war production has increased the maximum demand more rapidly than the capacity has been increased, thus reducing the margin of reserve.

Kilowatthour Output

Many estimates have been made regarding the probable trend of sales of electric power and kilowatthours in the immediate postwar period, a few of which will be shown as they cover a rather wide range. All of them predict some drop in kilowatthour output during the conversion period immediately following the war due to low industrial use while converting to peace time products. Figure 3 shows the estimates made by four separate utilities and one covering the United States as a whole. The most optimistic estimate shows that the kilowatthour output in the third postwar year will be greater than in 1943. Another estimate anticipates a drop of 18 per cent below the 1943 figure with a relatively slow recovery. The estimator for the entire nation is so pessimistic that he predicts a drop of 22 per cent below 1943 in the first year and a further drop of 6 per cent by the end of the third year, after which a steady recovery is predicted. The average of the four individual systems shows a drop in the first postwar year of 13 per cent, with a rise in output in the third postwar year to within 5 per cent of the 1943 output. In this chart the output for 1943 is used as 100 per cent in order to get comparable estimates.

Figure 4 shows similar information so far as maximum demand is concerned, and gives the estimates of the same four groups. The peak load of the winter 43-44 is used as 100 per cent, and the estimates at the end of the first full calendar year after the close of the war are the first points on the prediction. The most optimistic estimate shows a load in the first year 13.5 per cent higher than the 1943 peak in spite of a reduction of kwhr output. The most pessimistic shows a recovery to 94 per cent of the 1943 peak at the end of the third year after the war. One of the factors responsible for the larger increase in peak load as compared with output is the change back from war time to standard time, while another is the reduction in the amount of two and three shift work in industry.

It is evident that new uses for electrical service, some of which were just being developed and introduced prior to the war will be forthcoming—deep-freeze units for food preservation; electric ranges and water heaters, air conditioning, and other appliances which the manufacturers are planning and will develop will all find a part in the picture. All this will mean more business for the manufacturers who in turn will need more power to take care of their increased output. As only 33 per cent of the farms in this country had been electrified up to 1940, the possibilities of electricity for farm use surpass the most optimistic

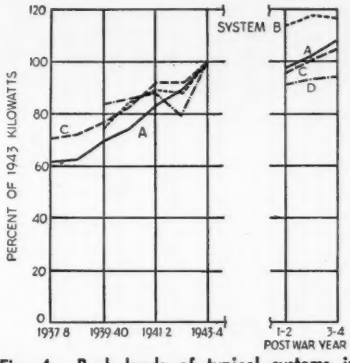


Fig. 4. Peak loads of typical systems in relation to 1943 loads

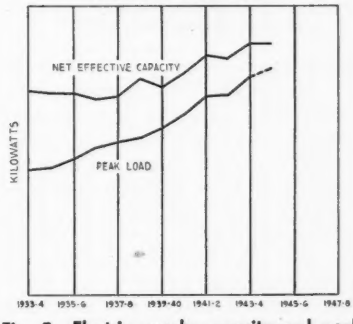


Fig. 5. Electric supply capacity and peak loads of Commonwealth Edison Group

salesman's estimate. The aggregate of these increases is bound to offset to a marked degree the decrease which will result from the reduction in war production activities, although there will probably be some lag, depending on the manufacturers' ability to supply the necessary equipment for these various services.

Figure 5 shows the steady increase in the load of the Commonwealth Edison Group of Companies from the winter of 1933 to the present time. The same condition with regard to excess reserve which prevailed almost universally throughout the country is evident in this group as well, but by 1938 when the first major addition to generating capacity was made, the margin of reserve had dropped to more nearly normal proportions. The installation of additional generating capacity was delayed due to war activities and the shortage of critical materials and labor so that the load in succeeding years has increased faster than the capacity. Additional generating capacity which was on order has been postponed or canceled by War Production Board orders.

Long Range Planning

You will want to know what we are doing about it. In the first place we are following very carefully the trends in various types of load and are studying the forces

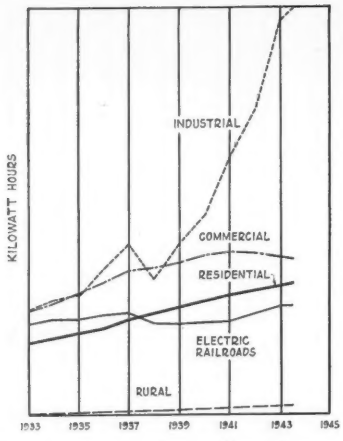


Fig. 6. Sales by customer classes, Commonwealth Edison Group

and conditions which produce these trends. Estimates are continually being made of increases and decreases in these different types of load and in turn these estimates are being checked to detect errors in the thinking or planning of those engaged in this work. Forecasts are thus being continually made not only for the immediate future but for several years ahead so that long range plans can be made.

In the systems served by the Commonwealth Edison Group of Companies, we have divided the customers into five classes; rural, residential, commercial, industrial and electric railroads. The kilowatthour sales by years to each of these classes are shown in Fig. 6.

In the 10 yr from 1933 to 1943, the industrial sales have more than tripled, a large part of this increase being due to the war effort. Rural sales have increased at a tremendous rate but they do not represent a large proportion of the total. Commercial sales have grown more slowly and have even fallen off in the last 2 yr due to the inability of small stores and small industries to get materials. The residential load growth has been steady through good times and bad. The supply to electric railways is neither increasing or decreasing with the exception of the last 2 yr when there has been some increase due to shortage of gasoline and tires.

Load Trends

In Fig. 7 the trend of the load in these various groups has been plotted. It is estimated that with proper sales campaigns, because of the new appliances and devices which will be brought on the market, and for other reasons previously mentioned, the residential output and load will double in the

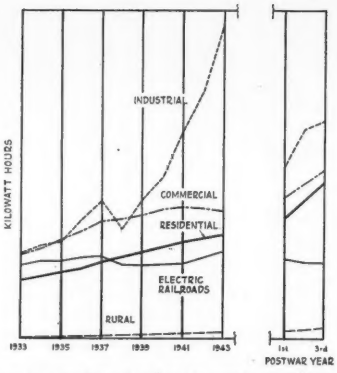


Fig. 7. Predicted sales by customer classes, Commonwealth Edison Group

first five postwar years. In the rural area where we now take care of about 82 per cent of possible rural customers it is expected that the load and the output will more than double. The commercial load is expected to recover promptly to levels higher than at any time in the past due to the improvement of business conditions generally and to the fact that money will be available for the purchase of all kinds of material and conveniences which have been unobtainable during the war. The railway load which has increased slightly during the war will probably taper off gradually as gas and tires for automobiles become available for transportation to and from work. The industrial load will probably drop back nearly to the 1940 level and from there on will again begin to rise. Just how fast these loads will change after the war will depend of course on the manner in which the war ends—consequently in all these charts a space has been left after 1943 which should indicate first, that we do not know when the war will end, and secondly, that we do not know how it will end, consequently we cannot predict the shape of the curve in this uncertain period.

Recovery in Three Years

The total system load of this group of companies will be back to present levels at the end of the third year after the war. This estimate is not so optimistic as some, but it is much better than some of the bluest pessimists' forecast. It must be borne in mind that estimates such as these are good only for the day or week they are made, and are subject to change without notice. Possibly they are influenced by a little wishful thinking as the three years' recovery period would allow about the right amount of time for building up reduced reserves in generating capacity and in rehabilitating the system. Both generating capacity and transmission and distribution equipment have been loaded pretty heavily not only because of greater loads and decreased reserves, but also because of the higher load factor which means longer hours of operation.

The utilities are fortunate in that the same equipment which serves wartime industries will serve civilian activities in peace time without material changes in the plant itself. It is true that some changes in distribution may have to be made to meet changed conditions of load; additions to generating capacity may be made and changes may be necessary or advisable in plant design or in operating practices, but these are items that occur in the normal operation of any electric utility. The utilities, however, will be dependent on the manufacturers from whom they purchase equipment for their own use and those who supply equipment and appliances for civilian use, consequently the speed with which the utilities and the public are able to resume normal activities will depend on the speed with which the manufacturers can convert to peace time activities.

Lessons Learned

The utilities have learned from their war experience something about simplification and standardization in the design and construction of their equipment and it is confidently expected that postwar designs and practices will be more economical than those preceding the war. We have found from experience that important wartime industries can be taken care of with simplified services and have proven that the dependability of electric equipment from the generating stations to the customer is of a much higher order than had previously been anticipated. The electric utilities expect that competition in other forms of power will continue in the postwar period, but they confidently expect to meet it as they have in the past and to prove again that in the long run utility service is more economical, convenient, and dependable.

In the postwar period electric utilities expect not only to maintain their fine record of continuous and dependable service, but to improve upon it and to increase their importance in the everyday life and activities of the citizens in their respective communities.

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

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For the Young Squirts

The abysmal ignorance of the younger generation is never more clearly demonstrated than in their reaction to mention of the valve-handle letter. When we, old timers, mention the matter they look at us blankly and ask, "what's that?" They never even heard of it! Of course, the valve-handle letter may not conform to the streamlined type of humor now characterized as sharp or on-the-beam but we always thought it funny and so, for the benefit of the young squirts who never heard of it we present the following version of the letter here. This particular version is one dug up by Carl Sandburg in writing an article in the Chicago Sun recently. It reads,

"Romulus, Mich., 7 Nov.
"Mister Joanes, Extra Tool Corp.

"Dere Frend,

"I got the valve which i by from you alrite but why for gods sake doan you sen me no handle. i Loose to my customer shure ting, you doan treet me rite is my money not so good as the other fello. I waste 10 daze and my customer he holler for water like hell by the valve. you know he is hot summer now and the win he no blow the weel, the valve she got no handle so wat the hell i goan do. you doan sen me the handle pretty quick i sen Her bak and I goan order some valve from the Henry Bitoff companee. Goodbuy. your frend.

"J——— B——— M———.

"Since I rite theese letter I fine the dam handle in the bocks excuse me."

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

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Fundamentals of Instrumentation and The Heat Balance

By DENARD L. GUSLER*

It was Lord Kelvin who said, "When you can measure what you are talking about and can express it in numbers, you know something about it." Most engineers can appreciate the truth of Lord Kelvin's statement. The operation of a power plant is a complex job and unless you can express the operation in terms of numbers you can know very little about what is going on. It is only through the use of instruments that the necessary accurate information can be obtained. This being the case, it is necessary for the power plant engineer to know what instruments to buy, where to install them, and finally, how to use the information they provide. In this article, our friend Mr. Gusler again employs his fine analytical powers to make this whole problem of instrumentation easier for everybody. He tells you what instruments to buy, where to put them and then shows you exactly how to figure the heat balance of your power plant. Many long winded discourses have been put forth on this subject but few of them we have ever heard cover the subject as clearly and as simply as does Mr. Gusler in this article. This is a common sense discussion for the practical man

A LARGE PART of the cost of operating a business concern goes into the accounting department where detailed records of all expenditures, depreciation, etc., are maintained as well as charts and records of production and selling. By keeping close track of each item the business organization is able to function with maximum economy in all phases of operation.

The power house, in a sense, is a business concern, whose purpose is to generate steam and electric power. To effectively produce steam and electricity at the least possible cost, every major element of input and output must be constantly measured and studied.

The promotion of greatest efficiency in all phases of power house operation is difficult, if not impossible, unless constant attention is given to the control of temperature, pressure, and flow. It is thus the duty of the engineer and the operator to see that his plant is instrumentated to the extent that measurement of these three quantities is readily possible because it is the only way that he can keep his plant in balance. Any other method is usually guesswork.

This is a simple discussion of the location and interpretation of pressure gages, thermometers, and flow meters in the power house. While it is not complete it is at least representative and might assist other operators in understanding the varied assortment of instruments that properly engineered concerns place at their disposal.

When a new operator puts in his first appearance in a modern power house, he is soon confronted with a congestion of piping that he will have to understand thoroughly before he can become a really capable operator. If he will, instead of trying to grasp the whole, take one of each mechanism, such as one boiler, one boiler feed pump, etc., and trace out the lines to and from a single mechanism at a time on a piece of paper, the result might easily resolve itself into a steam and water flow cycle such as shown in the accompanying diagram. This basic cycle will usually be the same, in an industrial power house, whether it is large or small. That is: make-up water and condensate returns to open heater, boiler feed pump, and to closed heater or directly to boiler if low pressure, and thence to prime mover or to process as necessary. Excess steam can be condensed or exhausted to atmosphere.

The diagram is a heat balance of no existing power house but was made up to illustrate the discussion presented in this article. Location of all instruments and their readings are as indicated on the drawing. Optional instruments, whose existence depends on the size of the installation, are drawn with broken lines.

It is not necessary to meter all flows and to show how this is so we will trace the entire steam distribution, starting with the integral-furnace boiler.

High pressure steam flows from the boiler to the main manifold and from this point is distributed to process, turbogenerator, and power house auxiliaries.

To find the volume of steam used by boiler feed pump; 40,000—(20,070 plus 18,620) equals 1310 lb per hr. The amount of steam to both air ejectors is 150 lb per hr. (This data under the established steam conditions is usually supplied by the manufacturer.) Then 1310—150 = 1160 lb per hr to boiler feed pump.

From the main condenser the steam condensate flows through primary and secondary air ejector condensers to the continuous blow-down heat exchanger and thence to the deaerator. This flow is metered as 2650 lb per hr, but since the condensate from the air ejectors is returned to the condenser, the actual turbine exhaust flow is 2500 lb per hr (2650—150 = 2500). The turbine extraction therefore must be 18,620—2500 = 16,120 lb per hr.

The extraction steam flows from the turbine to the low pressure manifold and is distributed to low pressure process and heating, to the closed heater, and through a reducing valve to the deaerator. The metered steam flow to the closed heater is 3015 lb per hr. Of this total, 1160 lb per hr is flashed from the flash tank and 1850 lb per hr is supplied from the turbine extraction. This is verified as follows:

The continuous blow-down water flows to a flash tank where some of it expands into steam and passes into the 25 psi system and the remainder travels through a heat exchanger to the sewer.

The amount of steam flashed is calculated from the formula:

The continuous blow-down water

$$\frac{Hb - Hf}{Vf} \times 100 \text{ (per cent)}$$

Hb — enthalpy of liquid at boiler pressure.

Hf — enthalpy of liquid at flash pressure.

Vf — latent heat of vaporization at flash pressure.

$$\frac{452.7 - 236.03}{933.7} \times 100 = 23.2 \text{ per cent.}$$

Water flow to boiler 45,000 lb per hr minus steam flow 40,000 lb per hr = 5000 lb per hr continuous blow-down.

5000 × 23.2% = 1160 lb per hr flashed into the 25 psi system.

Blow-down water to sewer is 5000 — 1160 = 3840 lb per hr.

3015 — 1160 = 1850 lb per hr supplied from turbine extraction.

The steam flow to the deaerator is as follows:

16,120 — (11,083 + 1850) = 3187 lb per hr which when added to the boiler feed pump exhaust gives the total steam to deaerator. That is: 3187 + 1160 = 4347 lb per hr.

Water leaving the deaerator flows through the boiler feed pump, thence to the closed heater and into the steam drum of the boiler.

A flow meter is not needed on the circulating water to condenser line as this flow can be calculated by taking into consideration reheat in the turbine.

In the theoretically perfect turbine all heat given up is converted into work and expansion is at constant entropy. In the actual turbine this is not the case. All the internal losses that occur in any stage of a turbine, with exception of radiation losses, are absorbed by the steam itself. Which gives more heat at the exhaust of any stage than would be available if the expansion was at constant entropy. This is reheat of that stage and it means that the quality of the steam is actually better than that indicated by the Mollier diagram. Unfortunately, though, there is no use for this reheat in the last stage and it passes to the condenser.

For all practical purposes the condenser may be assumed to absorb per lb of steam:

*Those who read the little biographical sketch about Mr. Gusler on page 85 of the January issue may be interested that he has again enlisted in the United States Marine Corps.

945 Btu for 1 in. Hg abs.
942.5 Btu for 1.5 in. Hg abs.
940 Btu for 2 in. Hg abs.

Then the steam leaving the turbine exhaust at 1.5 in. Hg as indicated in this heat balance will contain 59.71 + 942.5 = 1002.21 Btu, of which 942.5 Btu will be absorbed by the condenser circulating water. With a 2.5 F rise in temperature—

$$\text{Circ. water lb per hr} = \frac{2500 \times 942.5}{2.5}$$

= 942,500 lb per hr or

$$\frac{942{,}500}{8.3} = 113{,}500 \text{ gal per hr.}$$

These examples were presented to show how a few flow meters, well distributed, may be used to measure a large number of flows when balanced against each other.

Most of the instrument locations and corresponding steam or water conditions and Btu values are obvious but some that are not so obvious will merit further discussion.

Steam flashed from the flash tank will be relatively dry saturate at the flash tank pressure. The tank can be internally baffled to provide dry steam or, in some instances, the blow-down water expands in a manifold and enters the flash tank at a tangent with such velocity that centrifugal force flings out the water and steam flashes into the take-off line which is centrally located.

A thermometer is not needed on the blow-down water line to sewer from the heat exchanges but provision should be made to obtain this temperature when a check on the heat exchanger is desired.

Permanent thermometers on the condensate lines from the air ejector condensers are optional but thermometer wells should be installed so that this temperature can be checked when desired. Regardless of the condenser pressure some subcooling will usually result.

Ordinarily condensate leaving the main condenser will be cooler than the saturate temperature corresponding to the condenser pressure. In this instance a reheating hotwell was assumed which makes the condensate temperature correspond to the 1.5 in. Hg abs pressure.

The extraction chest should have a pressure gage as well as a gage in the extraction line. In computing the turbine efficiency when extracting the chest pressure and corresponding heat value should be used.

A thermometer is necessary in the extraction line near the turbine because the extraction steam, if not dry saturate steam, will be mildly superheated (unless the extraction pressure is very low).

Consideration is not given to condensate from traps in the power house in this heat balance because it is too variable a factor. However under this set-up condensate can be dumped into a storage tank and pumped up to the surge tank which makes it easy to measure the flow.

No pressure gages or thermometers are shown on the reducing valves because the enthalpy of the expanding steam remains the same. In actual practice, however, suitably located instruments, such as mentioned, are necessary to facilitate control. The reducing valve at "C", through which no flow is shown, is provided to supply 25 psi steam when the extraction regulator is out of service. This type of installation will likely require a desuperheater.

The information presented thus far, and illustrated in the diagram, should enable the practical operator to make up a heat balance in his own plant provided there is an adequate distribution of instruments.

When the heat balance is completed the steam and water flow can be checked to discover deficiencies and waste. When maximum possible results are obtained it then establishes a standard for future operation.

The use of the diagram does not end here. By using the information presented in applying practical formulas, the individual or group efficiencies of equipment may be checked. Some examples are as follows:

FACTOR OF EVAPORATION

$$\frac{hg - hf}{970.2}$$

hg — enthalpy per lb of steam leaving the boiler.

hf — enthalpy per lb of water entering the boiler.

$$\frac{1357 - 269.59}{970.2} = 1.12$$

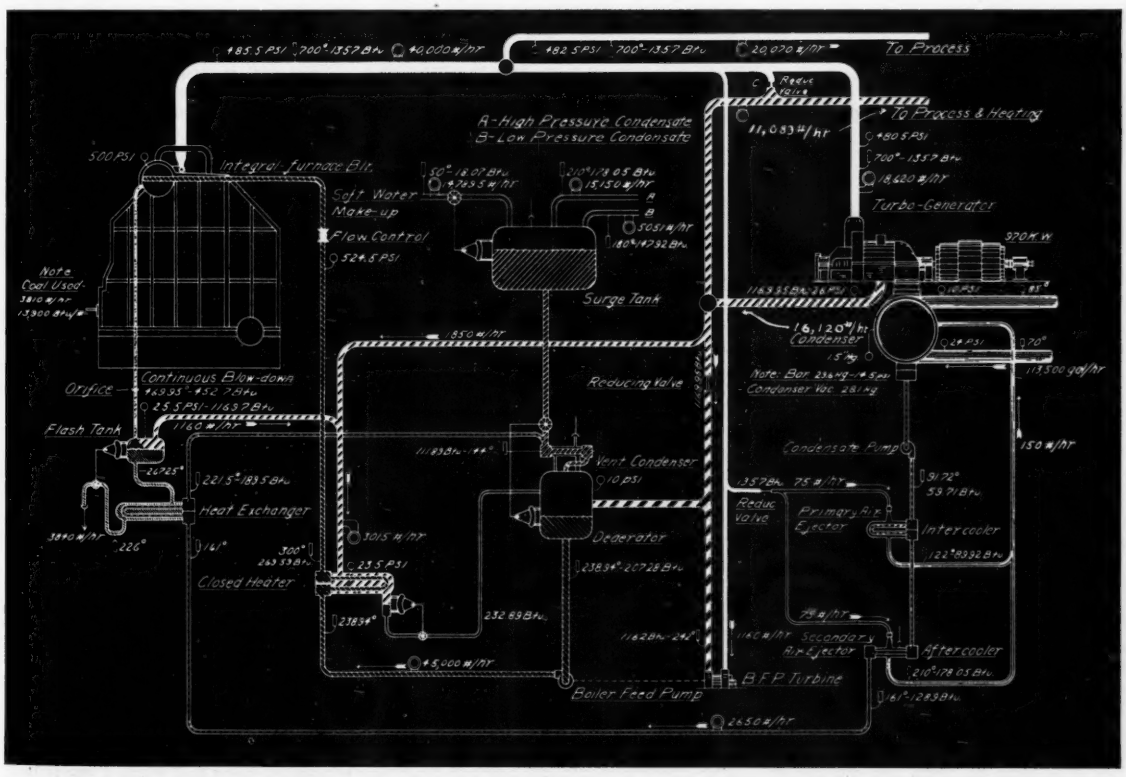


Diagram of a power plant showing the flow of water and steam and the location of the necessary instruments for the calculation of the heat balance

EQUIVALENT EVAPORATION

Actual evaporation × factor of evaporation.

$1.12 \times 40{,}000 = 44{,}800$ lb per hr.

BOILER HORSEPOWER

$$\frac{\text{Equivalent evaporation}}{34.5}$$

$$\frac{44{,}800}{34.5} = 1300 \text{ Bhp}$$

BOILER EFFICIENCY

$$\frac{\text{Output}}{\text{Input}}$$

Output — 40,000(1357 — 269.59) = 43,500,000

5,000(452.7 — 269.59) = 915,000

44,415,000

Input — 3810 lb per hr × 13,900 Btu = 52,200,000

TURBINE EFFICIENCY

$$\frac{\text{Btu delivered to generator}}{\text{Btu given up by steam passing through the turbine}}$$

Generator efficiency is 95% (this data supplied by manufacturer.)

$$\frac{970 \times 3413}{.95} = 3{,}480{,}000 \text{ Btu output}$$

15,120(1357 — 1123.5) = 3,530,000

2,500(1357 — 885) = 1,180,000

4,710,000 Btu input

Btu values 1123.5 and 885 obtained by tracing expansion of the steam under the operating conditions on the Mollier diagram.

$$\frac{3{,}480{,}000}{4{,}710{,}000} = 74\%$$

COMBINED EFFICIENCY OF BOILER FEED PUMP AND TURBINE

$$\frac{\text{Output}}{\text{Input}}$$

$$\text{Output} — \frac{524.5 \times 2.3 \times 45{,}000}{778} = 69{,}800 \text{ Btu}$$

Input — $1160 \times (1357 — 1162) = 226{,}200$ Btu

2.3 × pressure = heat in feet to be pumped against.

778 ft lbs = one British thermal unit.

$$\frac{69{,}800}{226{,}200} = 30.9\%$$

NOTE: These problems were worked on a 10-in. slide rule so there is that degree of accuracy to be expected.

It is evident that most of the figures used in these simple problems were taken directly from the heat balance in the diagram. These efficiencies afford a concise statement as to the performance of the equipment concerned. The operator can carefully determine the efficiency of his equipment from time to time and gradually work out a performance curve. Then when his curve begins to drop too low it is time to check the mechanism concerned and apply necessary corrective measures.

Performance of condensers, closed heaters, etc., can be checked with arithmetical formula but other methods are just as good. If the condenser tubes begin to plug up the drop in the circulating water pressure across the condenser will increase. It will be more difficult to maintain normal vacuum. If the closed heater tubes begin to scale it will take more steam to produce the same increase in feedwater temperature.

Faults of this nature can be discovered by making periodic checks under similar operating conditions.

The Application of Electric Arc Welding to the Lumber Industry*

IN THIS AGE of marvelous achievements it will not be of great surprise to those concerned to know that electric arc welding has been adapted to use in the lumber industry. After a great amount of research and many disheartening failures, we are now pleased to make public the fact that our engineers have, at last, accomplished their goal adapting electric arc welding to the lumber industry in general.

In the past when a timber contained many knot holes, splits and defects it was scrapped and consigned to the waste burner, but now, thanks to our engineers, by the use of the electric arc welding process and wooden electrodes, these timbers may be salvaged and turned out as clear stock at a very slight expense. In the case of timber to be used for spars, where a log of sufficient length cannot be obtained, it is a simple matter to use our arc welding equipment and specially prepared wooden electrodes No. 13 to join two or more logs to equal the required length, then by hewing the excess material away, obtain a spar equal to one cut from a single log. In case a plank is sawed too short or too thin, by using electrode No. 23 it may be built up to the required thickness and with No. 13 electrodes another plank of the correct length added.

It will be of interest to the engineers of the larger lumber companies to know that in connection with this work a number of special wooden electrodes with ionized sawdust coating have been developed. It is now possible to take an electrode made of southern pine and by using the proper ionized sawdust coating lay down a deposit of the finest mahogany.

These electrodes which are covered by patents are the secret of the process. By using these patent covered electrodes, it is possible to obtain any grade of wood desired. Our No. 13 electrode is especially recommended for use where one section of timber is to be added to another. Number 23 electrode is used for general building up but where various grades of extra rich grained woods are required special electrodes can be prepared.

Wooden electrode welding is accomplished by attaching the work to the grounded neutral of a three phase system and using three electrodes, one connected to each phase. With these ionized sawdust coated electrodes connected to each phase of the power line a very rapid deposition of material is possible. In fact this is one of the few applications best suited to AC welding because with it a minimum amount of charcoal inclusions are obtained.

This process of arc welding should be of great interest to the Boards of Park Commissioners and the Chief Foresters of the larger cities as by its use the practice of using concrete to fill decayed spots in trees may be eliminated. By using electrodes of the 200 series, wood of the same material as the tree may be deposited. By finishing the job with a 200 B electrode a fine layer of bark may be put on which will defy detection by experts.

When applied to frame building construction the resulting building will be as rigid as a single piece of wood or the mighty Oak. The general adoption of the process will eliminate the familiar rat-a-tap-tap of the carpenters' hammer and the buzz-buzz-buzz of the carpenters' saw in the most elite and restricted residential districts of our beautiful cities.

Inquiries regarding these new and wonderful discoveries will be gladly answered by the members of the Wooden Research Board. All such inquiries should be addressed to Mr. Beech or Mr. Logg who are assisting the writer on this Board.

WILDWOOD ELECTRODE MFG. CO.
Per (Signed) Douglas Fir
Chief Engineer and Fireman
Wooden Research Board

*This fascinating announcement of one of the most astonishing achievements of science is presented here to prove that POWER PLANT ENGINEERING is always first with the latest. No other publication can make that statement. We don't know exactly where this account came from but one of our editors who attended the Midwest Power Conference in Chicago last April found it in his pocket when he recovered from the effects of the conference. He couldn't explain it satisfactorily; mumbled something about a guy named Joe— or was it Yohnson, he couldn't recall—giving it to him. Anyway, there it was, perhaps the most startling development of this age, notwithstanding plastics and spot radio announcements. Don't ask us for further information about it and don't ask us for the address of the Wildwood Electrode Co. We don't know where they live and, furthermore, we don't care. Editor.

Lubricated Lathe Center

A SPECIAL LUBRICATED lathe center devised at General Electric's Pittsfield Works prevents shaft centers from "picking up" when machining heavy shafts.

Lubricant is introduced into the hole in the center of the shaft by a pressure gun through a fitting on the shank of the lathe center. It is forced into the shaft center and when full it is indicated by exuding along a 1/16 by 1/16 in. groove on the outside of the lathe center. As the shaft turns, the lubricant is wiped against the shaft center. The groove is positioned where there is low pressure between the machine center and the shaft center. This obtains the best possible adhesion of the lubricant to the shaft center.

With this arrangement, the shaft center can be lubricated while a cut is being taken, and it is easy to keep the lubricant free from foreign matter.

Tricks for Doing Tough Jobs

By J. R. KENNEDY

IN INSTALLING boilers or other equipment requiring the use of pipe, it is often necessary to remove broken pipe, bushings, etc., that have too short a "stump" to permit removal with a pipe wrench. Sometimes one hits some really tough jobs, but when the parts cannot be discarded for a substitute, as when a reducer or pipe breaks off smooth with the surface of a shell boiler, the job must be done regardless of how much time is required.

The following suggestions may help. When it is found difficult to remove a cast-iron bushing with a cold chisel, it may help to make two cuts with a hacksaw, close together, but not deep enough to injure the threads in the "female" part. Then the narrow strip between the cuts can be knocked out with the cold chisel, loosening the remainder in most cases so that it can be screwed out or possibly knocked out with the cold chisel.

The same method referred to above may be helpful in removing pipe; but if the pipe is thin and comparatively soft, one cut with a hacksaw may suffice, after which the pipe may be crushed with a cold chisel.

When a solid bushing or pipe refuses to move under pipe wrench pressure and it is desired to remove the article intact, it may help to heat both male and female quite hot. Then apply cold water to the male promptly, exercising care to get as little water as possible on the female. After the male has been shrunk by this method, it may be easily removed in most cases.

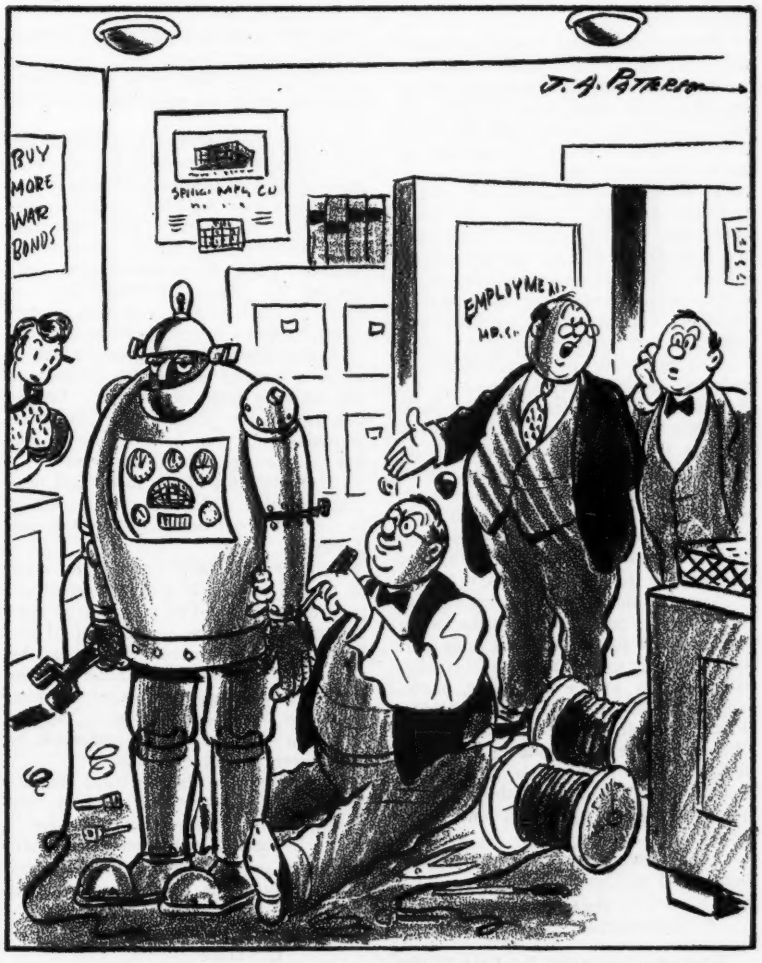
One may save time by discarding unions or couplings that contain broken-off pipe, provided one has some extras which can be used as substitutes; but if no substitutes are available, then one can remove the pipe by weakening with a hacksaw and knocking out with a cold chisel, as recommended above.

The nature of some parts does not permit the application of heat to a degree that would result in loosening, even if the male could be shrunk by applying cold water. Consequently, the choice of a method is governed largely by the nature of the parts and the job to be done. Movable parts may be heated in an ordinary forge, immovable parts by a blow torch or welding torch, depending upon what is available.

The manufacturers of inspirators, injectors, and certain other water-moving apparatus, are thoughtful enough to provide inside projectors, "bumps" cast-in-position, to permit removal of short nipples and union parts without having to apply a pipe wrench where its teeth would bite into a finely-finished joint, resulting in a leak upon re-assembling the parts. Such parts are usually made of brass, and can usually be removed by inserting some metal article, such as bar iron of suitable size, into the opening, and turning with an ordinary wrench. The corners of the bar do not permit it to slip past the projections or bumps when the bar is rotated, but such "tools" should fit pretty snugly inside the article one desires to remove or tighten.

Considerable damage can be done by using pipe wrenches on finished articles which depend upon accuracy in fitting for efficiency, and careless use of tools not only results in damage to machinery but often to the tools as well. (I have lately been working in a repair shop where a pair of bolt clippers has been put out of use by trying to cut high-carbon steel—something harder than the blades themselves. In the same shop is a 24-in. pipe wrench that has been ruined by using it on a job requiring a heavy chain wrench. On one occasion I saw a "green" worker break a center punch by trying to use it as a knock-out punch. Learning how to use and conserve tools is one of the first fundamentals.) Care and patience must be exercised when one strikes a job for which it seems that a suitable tool has not been manufactured.

Removal jobs are usually tougher than actual construction. For instance, just recently, I had to remove some broken-off stud bolts from the front end of a horizontal shell boiler before a suitable "front" and smoke stack rest could be fastened in position. I thought about burning the studs out with a welding outfit, re-threading the holes, and starting all over, possibly using larger studs as renewals; but due to the close proximity in this particular case of the studs to some flues and braces, it was suggested that I drill out the old studs and use the old hole sites as far as possible. This job happened to be far from a real shop; and since I had nothing but a ratchet drill, I had to build a scaffold about the front end of the boiler, and rig up a prying outfit to put pressure on the drill. Before finishing the job I wished for an electric drill, with magnets to hold some sort of frame in position on the boiler after spotting or lining the drill with the hole site. I believe magnets will be used in the future to hold light, portable tools in line with work, thus making tough jobs easy. I also think we ought to design more tools for the occasional, but hard-to-do, "tough" jobs.



"It's our employment manager. He decided to handle this help shortage business in his own way."

Preventing Corrosion of Machinery and Power Equipment

Corrosion is an electrochemical process. Factors affecting corrosion. . . . Methods of controlling and preventing corrosion. . . . Use of paint in preventing corrosion. . . . Factors to keep in mind when selecting a paint to prevent corrosion

By TYLER HICKS

THE AVERAGE power engineer is well aware of the effects of corrosion on the machinery in his plant. Because it is one of the factors which gradually tend to decrease the efficiency of a plant as a whole, a knowledge of the causes of corrosion will enable the plant engineer to combat it with the result that breakdowns and outages will be prevented.

Corrosion of metals is generally considered to be an electrochemical process. Briefly, the damage is caused by an electrochemical reaction which takes place at the surface of the metal, resulting in a gain and loss of electrons at two different points, and consequent solution by ion formation of some portion of the metallic surface.

The electrochemical theory postulates that every metal has a definite solution pressure and that when immersed in an electrolyte will enter into solution with the formation of metallic ions. Hydrogen ions are forced out of the solution by the metallic ions and plate out on the metal surface as molecular or atomic hydrogen and thus restore the ionic equilibrium of the system. Unless the hydrogen gas formed can leave the metal surface as bubbles or an oxidizing agent is present to remove the hydrogen by chemical combination, polarization will occur and the corrosive action will stop.

The metal ions in the solution, and hydroxyl ions which are formed by the dissociation of the water in the solution, may unite to form a metal hydroxide. If this metallic hydroxide is insoluble and forms an adherent,[1] nonporous coating on the metal, the metal will be protected from contact with the electrolyte and further corrosion stops or is governed by the permeability and solubility of the protective layer.

Any condition which removes the protective layer, prevents its formation or leads to the formation of soluble corrosion products, will increase corrosion. High velocity of the electrolyte, particularly with the presence of air bubbles which can disturb or remove a protective film by erosive or impinging action, or the presence of chemicals which form soluble metallic salts of the metal in question, will all act to promote corrosion.

The factors affecting corrosion have been listed as follows:[2]

The Metal

1. Electromotive Position
2. Purity
3. Nature of Impurities
4. Physical State
5. Oxide or Surface Behavior
6. Salt Solubility

The Corroding Medium

7. Nature of Cation
8. Concentration of Cation
9. Conductivity
10. Diffusibility
11. Nature of Corrosive Products

External Influences

12. Oxygen Concentration
13. Light
14. Colloids
15. Bacteria
16. Cathodic Metals
17. Stray Currents

A brief summary of each of these factors is given below.

1. The higher the metal in the electromotive series the more readily will it corrode.

2. Very pure specimens of metals resist corrosion enormously, but absolute homogeneity is commercially impossible.

3. Impurities are either more or less noble than the metal. The impurities will generally increase the amount of corrosion. For more information concerning the effects of impurities, the reader is referred to any treatise on the hydrogen overvoltage of metals.

4. Any portion of the metal which is under a greater stress than elsewhere will be more likely to corrode. Corrosion around the punched holes in boiler breechings and fan housings is the result of the stress in these areas.

5. Oxide films of the metal will prevent corrosion. The film must be stable in order to resist destruction by external elements.

6. If soluble salts form as a result of corrosion, then it proceeds rapidly.

7 & 8. Ninety-five per cent of corrosion is due to the replacement of the hydrogen in the corroding medium by the metal. Examples of other cations than hydrogen are the action of mine water on machinery (copper), and the corrosion of nickel milking equipment by the copper content of milk.

9. The greater the electrical conductivity of the corroding medium the greater will be the rate of corrosion.

10. Diffusion depends on temperature, viscosity, and circulation. The greater the diffusion, the greater will be the corrosion.

11. Corrosion products may be
    1. Soluble
    2. Adhere to metal, impervious to ions, and insoluble.
    3. Prevent oxide film formation.

12. Where hydrogen is evolved, oxygen concentration plays little part. Where hydrogen polarization asserts itself and a current does not flow, oxygen concentration is most important. Where oxygen access is not hindered by corrosion products, a protective film may form and remain; where access of oxygen is inhibited, a protective film cannot form and the oxygen acts as a depolarizer of the hydrogen, and corrosion proceeds.

13. Light is a form of energy and where it is absorbed, the absorbing medium must make use of the energy in one form or another. Metals have their solution potentials increased and so corrode more readily. Ultraviolet light accelerates corrosion markedly.

14. Colloids may be absorbed on the metal surface and if adherent protect it from corrosion, or they may increase the viscosity of the solution and so hinder the flow of the ions and therefore decrease the corrosion rate. When used as such, they are known as inhibitors.

15. Bacteria may affect corrosion by
    1. Changing oxygen concentration (aerobic forms).
    2. Formation of active end products such as sulfides.
    3. Formation of an incrustation influencing oxygen concentration.

16. When a more noble metal is present in a medium in contact with a less noble metal, the latter will corrode. The closer the contact, the greater the corrosion. Brass piping should not be connected to iron piping. A ship with a Monel metal hull and steel rudder, when launched in salt water corroded so rapidly that it never sailed.

17. Stray leaking currents from power lines result in buried metallic bodies, such as gas and water mains, in corroding at the points where the electrons are leaving on both the power line and the pipes.

To prevent corrosion one or more of the following factors may be introduced.

1. Alloying
2. Removal of strains
3. Polishing
4. Producing insoluble oxide coatings
5. Producing insoluble phosphate coatings
6. Electroplating
7. Covering with metals other than by electroplating, dipping and ing
8. Covering with non-metallic materials
9. Treatment of corroding medium
10. Addition of inhibitors to the medium.

Of the ten ways listed above by means of which corrosion may be controlled, only one may be used by the operating engineer. Corrosion caused by dissolved oxygen in the boiler feedwater is disregarded here because the field is too large. The operator can prevent corrosion by the use of the proper paints on the machinery in his charge. The following factors should be kept in my mind

[1] Anaconda Publication, B-2 Fifth Edition, 1940.

[2] Rohrman, J. Chem. Educ., 10, 215, (1933)

when selecting a paint which is to be used on metal surfaces.[8]

1. Basic substances in sufficient concentration inhibit the corrosion of iron. Basic pigments that are effective for this purpose are litharge, red lead, blue lead, white lead and zinc oxide.

2. Chronic compounds, even in great dilution, prevent the corrosion of iron. Chromate pigments that are similarly effective when used in sufficient amounts are as follows: basic lead chromate, normal lead chromate, and zinc chromate.

3. Neutral substances that do not ionize to acid reaction are considered inert. So-called neutral or inert pigments, which do not excite corrosion, produce with linseed oil a very durable film. Such pigments include black, brown, and red oxides of iron, china clay, silica, talc, and barium sulphate.

4. Substances that form a galvanic couple with steel in the presence of moisture cause rapid corrosion. Pigments which act in this fashion (graphite, carbon black and lampblack) are used only as the constituents of the finishing coats on steel surfaces, when first insulated from the metal by a coat of basic or chromate pigment paint. These carbon pigments with linseed oil form very durable and water-resisting coatings.

[8]Gradner, "Metal Protective Paints" Trans. Amer. Electrochem. Soc. 1921.

Arc Welded Back Pressure Relief Valve

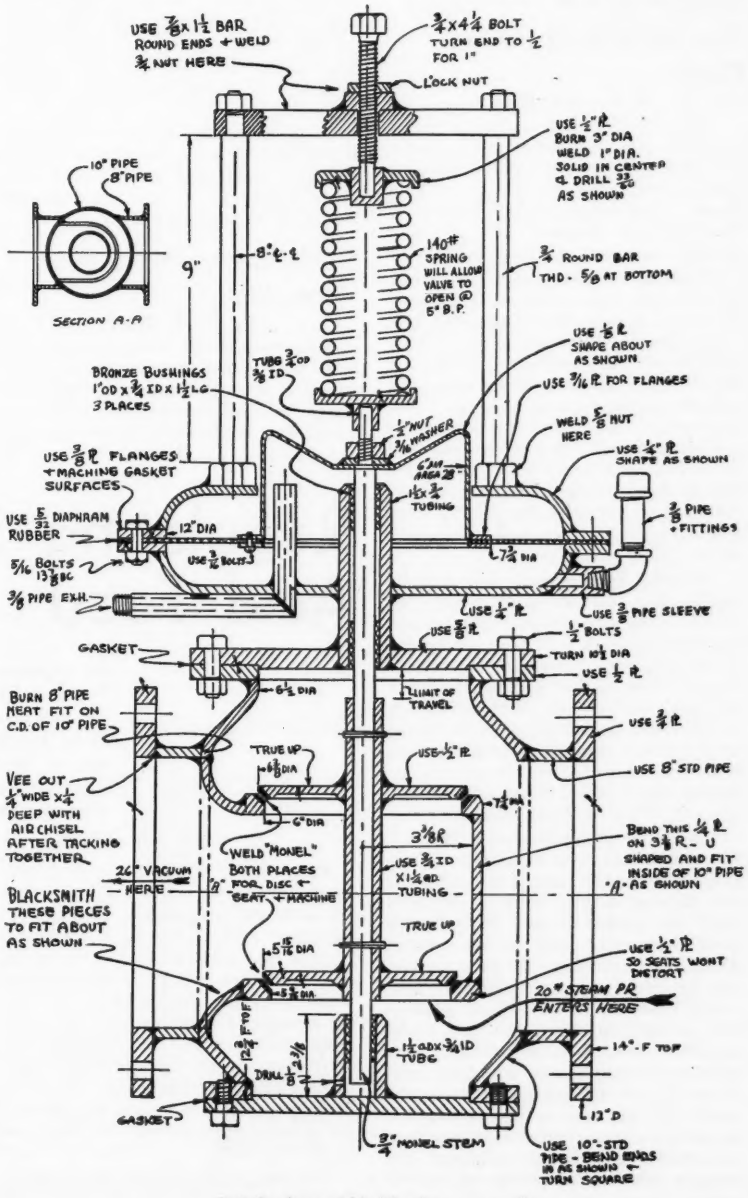
AN 8-IN. valve formerly listed at from $275.00 to $350.00 with a cast iron body and trimmings and it was practically impossible to purchase them at all with steel body and steel parts. With a combination blacksmith, welding and machine shop that is maintained at the Mississippi Valley Barge Line Co., this 8-in. back pressure valve can be made within a period of 48 hr by having different parts in work at the same time, whereas an all steel manufactured valve would require 6 to 8 months and an ordinary cast iron valve would be special and would take 4 months in ordinary times and at least 10 months now on a high priority. This valve was approved by the United States Coast Guard for marine use.

Detailed drawing shows this new way to construct an arc welded steel Back Pressure Relief Valve using pipe, plates and tubing. Itemized cost data is as follows:

8 in. pipe	$ 4.00
10 in. pipe	5.50
50 lb steel plates	2.00
Steel tubing and small pipe	3.50
Steel bars	.75
Bolts, nuts and washers	1.20
Gaskets	1.00
Diaphram	2.60
Bronze bushings and taper pins	1.20
Monel stem	1.75
Steel welding wire	.90
Monel welding wire for seats	1.20
Spring from ⅜ spring wire	2.90
Total for material	$28.50
Labor—Burning pipes and plates to detail sketches, 6 hr @ 1.00	6.00
Machining plates and pipes prior to welding, 6 hr @ 1.00	6.00
Tacking pipes and plates and tubing together and veeing out with air chisel for inside and mountside welds, 16 hr with helper @ 1.75	28.00
Swaging of the ends of the 10 in. pipe and blacksmithing of plates to make the "U"-shaped piece and to fit it into the 10 in. pipe. Sketches furnished to work to 4 hr @ 1.00	4.00
Blacksmith helper, 4 hr @ 75c	3.00
Heating the entire piece after all welding is complete to red heat to stress relief the welds, 3 hr blacksmith and helper @ 1.75	5.25
Machining the 15 pieces and assembling as shown, ready for operation, 37 hr machinist time @ 1.00	37.00
Total for labor	$89.25
Material	28.50
Overhead, 60% of labor	53.55
Total cost of valve	$171.30

This type of back pressure valve is used in exhaust pipe lines leading from a steam or turbine where exhaust steam is required for a heating system or for feedwater heaters at say 20 lb pressure. When the pressure builds up above 20 lb, the double discs raise and allow the excess to pass through the valve to the condenser or to the atmosphere as the case may be.

The spring can be adjusted for whatever pressure is required to be maintained, the spring pushes down


USE ⅞ x 1½ BAR ROUND ENDS + WELD ⅞ NUT HERE
¾ x 4¼ BOLT TURN END TO ½ FOR 1"
LOCK NUT
USE ½" PL BURN 3" DIA WELD 1" DIA. SOLID IN CENTER & DRILL 33/64 AS SHOWN
10" PIPE 8" PIPE
SECTION A-A
9"
8" C. to C.
140# SPRING WILL ALLOW VALVE TO OPEN @ 5# B.P.
¾ ROUND BAR THD. 5/8 AT BOTTOM
USE ⅛ PL SHAPE ABOUT AS SHOWN
USE 3/16 PL FOR FLANGES
BRONZE BUSHINGS 1" OD x ¾ ID x 1½ LG 3 PLACES
TUBE ¾ OD ⅝ ID
½" NUT ⅞ WASHER
WELD ⅝ NUT HERE
USE ¼" PL SHAPE AS SHOWN
USE ⅜ PL FLANGES + MACHING GASKET SURFACES
6" Sch 20
1½ x ¾ TUBING
USE E 32 DIAPHRAM RUBBER
12" DIA
⅜ PIPE + FITTINGS
⅝ BOLTS 13⅜ BC
USE ⅝ BOLTS
7¾ DIA
⅜ PIPE EXH.
USE ¼" PL
USE ⅜ PIPE SLEEVE
GASKET
USE ⅝ PL
½" BOLTS
TURN 10¼ DIA
USE ½ PL
BURN 8" PIPE NEAT FIT ON C.D. OF 10" PIPE
6½ DIA
LIMIT OF TRAVEL
USE ¾ PL
TRUE UP
USE ½" PL
USE 8" STD PIPE
VEE OUT ¼" WIDE x ¼ DEEP WITH AIR CHISEL AFTER TACKING TOGETHER
6⅛ DIA
6" DIA
1¼ DIA
BEND THIS ¼ PL ON 3⅜ R. - U SHAPED AND FIT INSIDE OF 10" PIPE "A" AS SHOWN
3⅜ R
WELD "MONEL" BOTH PLACES FOR DISC ⅛" SEAT + MACHINE
USE ¾ ID x 1½ OD TUBING
24" VACUUM HERE
BLACKSMITH THESE PIECES TO FIT ABOUT AS SHOWN
TRUE UP
5 15/16 DIA
USE ½" PL SO SEATS WONT DISTORT
5¾ DIA
20# STEAM PR ENTERS HERE
2¼ TYP
DRILL 21/64 x 2⅜
1½ OD x ¾ ID TUBE
14" F TOP
GASKET
12" D
¾" MONEL STEM
USE 10" STD PIPE - BEND ENDS IN AS SHOWN + TURN SQUARE

Details of arc welded back pressure valve

and the steam to be controlled enters through the ¾ pipe under the diaphram pushing up. Thus, if the spring is set to hold discs exactly tight on their seats when 20 lb pressure of steam enters the 8 in. pipe line the valve will not function, but if 21 lb pressure enters, the discs will raise and allow the extra one lb of pressure to escape, thus maintaining 20 lb pressure in the 8 in. line leading to the valve.

While this regulation of back pressure is a standard method used on various types, Mr. Elliott stresses the saving in cost with a minimum of delay by this method of fabricating and welding the valve assembly.

This was one of the Prize Winning Awards in the Monthly Arc Welding News Contest conducted by The Hobart Brothers Co. manufacturers of Electric Arc Welders and equipment.

The Six W's in Power Plants

By Thomas M. Street

"Boys," our old chief Scotty would say, after we had gotten things under control and back to normal, "you boys want to be engineers; why, God only knows. But since you're determined, there's a little doggerel that fits engineering, and worth remembering."

Lighting his pipe and settling back in his chair, he continued. "It goes like this. I have six friends—the best I ever knew. They are What, Where and When, and Which and Why and Who. These apply to engineering and humans, though not necessarily in the order given. No matter how well made and honestly built, no machine can stay on the job and do its work, unless the man in charge knows the What, Where, and When, along with the Which, Why, and Who, of them, as well as of himself.

"I said," he continued, with a quizzical smile, "that these W's apply to men as well as machines. I'll let you figure out how they fit you, but as far as machines are concerned, it is more simple. Why is that machine fitted for the work it's doing? What makes it click? When is it doing its work properly? Where are its weakest points, and Which are the most vital and important ones? What must I do if and When it fails and What made it fail?

"What is a power plant? The answer is obvious, you say. It's to furnish light, power and what not. As far as our customers are concerned that's the correct answer and all they care about. But with us it's another thing. It's a chemical laboratory. We, like the professor, are handling the concealed forces of nature; taking them in the raw and converting them into useful servants. We, like the professor, can mix two wrong things and blow ourselves into 'steen parts, so the coroner won't have anything to investigate. Or we can mix them rightly, in their proper proportions and proper relations, and bring a grin of satisfaction on our directors' faces, and peace and comfort to ourselves in the shape of fatter pay envelopes.

"Just as the professor must know the nature of the chemicals he is mixing, which two mix, why they combine together, and where they work best, or when they do not, so must we know of the machines we have in our laboratory. The wise chemist knows he must use judgment. He cannot favor one, and discriminate against another. He knows the right proportions of each that belongs in the mixture. The engineer, who is an engineer, knows all the six W's of his business and a whale of a lot more I haven't mentioned, but which you can no doubt figure out yourselves.

"I would like to add," Scotty said, "there's a lot of Gremlins we have to watch out for. They are legion, and busy little devils. Just to mention a few—Doubt, Suspicion, Carelessness, Passing the Buck, Jealousy, Big Head, Know It All, Discouragement, and, worst of all, Don't Care. These are busy little devils and are perched on our shoulders night and day, but if we call in the six W's we have 'em licked.

"A good business maxim is from the Good Book. It says, 'He that is faithful in a few things will become ruler over many things.' Here comes the graveyard shift. Good night, boys."

Don't Copy This Safety Valve Idea

By C. T. Baker

RECENTLY WHEN looking over a new boiler plant installation my attention was attracted to the manner in which the safety valve discharge connection was made. This is shown in the accompanying sketch.

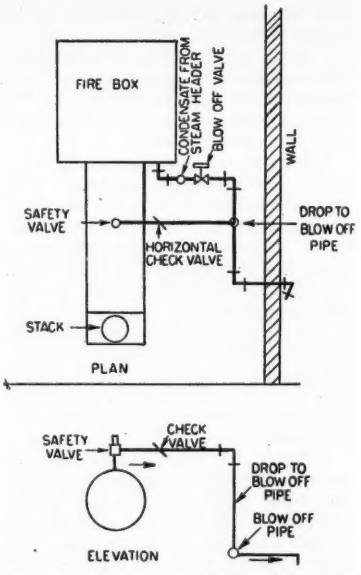


Diagram showing so-called safety valve connections

The spring loaded safety valve was placed about 12 in. above the boiler shell with its discharge pipe run to a point near the building wall then downward to a tee in the blowoff pipe.

Between this tee and safety valve at a point about 18 in. from the valve, a horizontal check valve had been placed as indicated.

The boiler was a fire box type and carried 100 lb pressure.

I thought, this is one for the book sure enough.

Regulating Sulphuric Acid Feed

As explained in the analysis of the solutions to Problem 33 on page 112 of the May issue, space was not available in that issue for the presentation of all the best letters. For this reason, the discussion of the problem is continued here. While the solutions presented here were not among those winning awards, many contain good suggestions

PROBLEM 33, it may be recalled, concerned the development of a method for accurately regulating the flow of sulphuric acid to an open feedwater storage and mixing tank — something that would not cost too much and that would feed the acid in proportion to the amount of feedwater drawn by the boiler feed pumps. The arrangement which was in use is shown in the accompanying diagram (Fig. A). One trouble with this arrangement was that the flow of acid varied with the head in the acid line.

Various methods were suggested in the May issue. The simplest, and probably the most effective, was in the use of a small chemical feed pump on the main boiler feed pump and arranged so that the chemical pump would operate by the action of the feed pump itself.

To show how different men approach a problem of this kind in different ways, the solution of Charles McCaleb is shown in Fig. 7.[1] This method also regulates the acid flow in accordance with the rate at which the boiler feed pump, pumps water to the boiler but it does it in an ingenious way. Writes Mr. McCaleb:

[1]Figs. 1 to 6 appeared in the May issue.

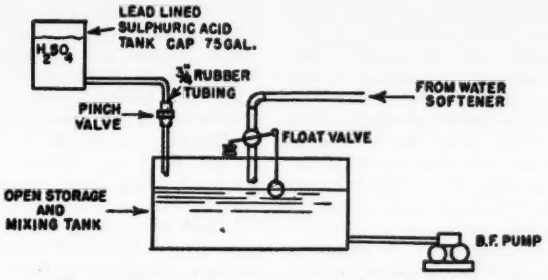


Fig. A. The arrangement presented by "Our Hero"

"I assume that the feed pump in this problem is of the reciprocating type. Since the problem states that the acid feed must be proportional to the amount of water handled, our first problem is to obtain an impulse which is proportional to the amount of water pumped. As I see it, there are three ways of obtaining this impulse for operating the proportional feeder:

1. The position of the float valve indicates the amount of water entering the tank, but it is not always correct since the supply line pressure and tank level may vary.

2. A perfect control set-up could be obtained by inserting an orifice in the feedwater line and by installing the necessary feeding equipment to go with it. Since this is a small plant I would hesitate to recommend it due to the cost.

3. The travel of the pump rod is an accurate measure of the volume of liquid being pumped. In view of the simplicity of this method I shall confine my discussion to this method as I do not feel that the first two warrant any consideration for this set-up.

"As shown in Fig. 7, my proposed mechanism consists of a shaft supported between two bearings and upon which I have mounted a drum D with thumb screw to secure it to the shaft, a ratchet wheel, also secured to the shaft, and a ratchet fork which is brass bushed and which floats on the shaft and carries the pawl which operates the ratchet wheel."

Without quoting Mr. McCaleb's description of his mechanism, the operation of his device will be quite clear from his drawing. As the piston rod of the feed pump moves back and forth the drum D slowly rotates. This causes the cord on the drum to unwind and lower the glass spout at the end of the feed tube, and this allows more acid to feed into the water. If the pump stops, the acid feed stops. By using pulleys in conjunction with the drum D it is possible to locate the acid tank at a considerable distance from the main shaft. After the acid tank has been emptied and is due for refilling, it becomes necessary to loosen the thumb screw on the drum D and rewind the cord. After the cord has been rewound, fill the acid tank and the feeding cycle repeats.

Thomas W. Kraus of St. Louis, Mo., offers a solution that approaches the problem from an entirely different angle, yet his solution is very practical. He proposes the use of a water-jet eductor in the line from the water softener. A diagram of his proposal is shown in Fig. 8.

"The problem," writes Mr. Kraus, "must be solved in two parts; the variable of correct proportions of acid, and the variable of intermittent flow. We will attempt to solve the last-mentioned first. How are we going to get a flow of acid that will automatically stop when the flow of feedwater stops? The solution of this should rest somewhere in a device that is dependent upon the feedwater for its source of energy. In other words, the force necessary to move the acid from the storage tank to the softened water should be the *flow* of the softened water to the storage tank. (In Our Hero's set-up, he used the force of gravity.) We do not want to use gravity, since gravity is a constant force and is in no way dependent upon the flow of feedwater. I propose as a source of energy a simple water-jet-eductor using the flow of feedwater itself as the source of energy. All of us are familiar with this device, and many of us have used it in emptying sumps, wells, etc. It works with steam, water, or

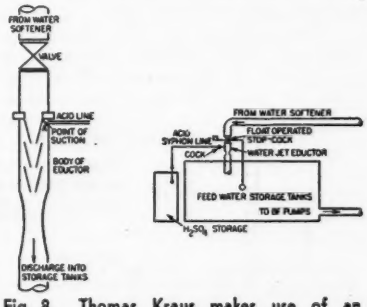


Fig. 8. Thomas Kraus makes use of an eductor

air; the only requisite being that the discharge pressure be less than the initial pressure of the source of energy. The installation of a water-jet-eductor on the line from the water softener would be the solution to the problem of obtaining a flow that will cease when the flow of water ceases. Briefly, the theory behind all this is: the flow of water through the eductor creates a suction at 'A' (see Fig. 8). The amount of suction will vary in proportion to the amount of water passing through the eductor; and when there is no flow of water, there will be no suction and consequently no flow of acid. Two things must be remembered in this installation: First, the supply of acid must be at a lower level than the point of suction at the eductor, or the force of gravity will feed acid into the line without regard to flow; and secondly, the eductor must be installed in the line beyond the float-operated valve, since if it were before the valve, the normal head on the line would force water through the acid line when the float-operated valve was closed.

"The answer to the first problem, obtaining the correct proportions of acid, lies in some sort of restriction in the line of flow and this can range from a simple pinch clamp to a remote controlled valve or meter that regulates the amount of acid directly with the pH of the softened water. Since Our Hero does not have much money to spend, it would seem that a glass cock of the type one sees in chemical laboratories would be the choice. This type of cock is economical and has the advantage of allowing the operator to *See* how far the cock is opened and 'feel' would not be nec-

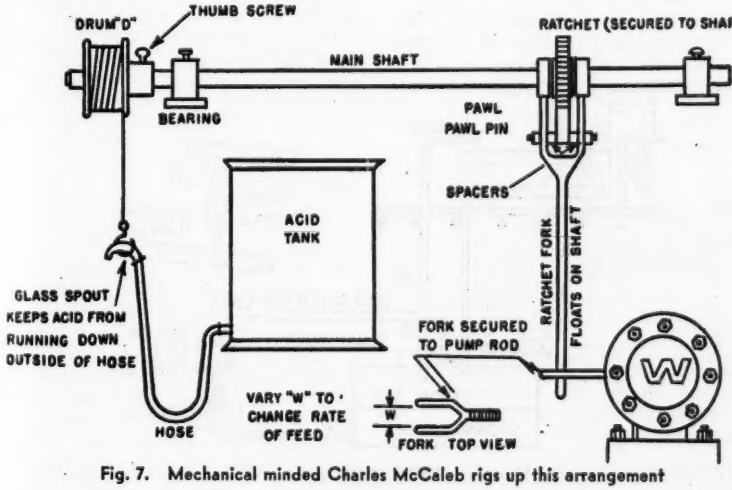


Fig. 7. Mechanical minded Charles McCaleb rigs up this arrangement

essary. The relationship between rate of flow of feedwater, amount of suction, and rate of flow of acid should all be one variable based on the rate of flow of the feedwater. Incidentally, this set-up would take care of the proper mixing of the water and acid, since the action of the eductor causes quite a bit of turbulence. In closing, the initial installation of this equipment would require considerable adjusting; however, once adjusted, it should take care of itself."

Joseph A. Kendrick of Baltimore, Md., makes two suggestions, one which is similar in some respects to the one just described by Mr. Kraus, and the other makes use of a motor driven chemical feed pump.

"The problem," says Mr. Kendrick, "does not state whether there is a suction lift in the suction line of the feedwater pump. If the diagram shows the actual elevation relation of the storage tank and the pump, it is possible that there is no dynamic lift. If, however, there is a lift, that is, if any time while the feedwater pump is delivering water to the boiler the pressure in the suction line falls below atmospheric pressure, it may lift the sulphuric acid from an acid tank located as shown in Fig. 9A. If the pump has sufficient suction to lift the acid it would be fed about in proportion to the volume of water delivered.

"Sulphuric acid has a specific gravity of 1.84 or nearly twice as heavy as water, therefore the maximum head H-1 should not exceed 8 ft, or approximately one-half the suction lift ordinarily used for water pumps.

"If the suction is not sufficient to lift the acid with the equipment arranged as shown in Fig. 9A, the arrangement shown in Fig. 9B may be utilized. This arrangement employs a motor driven acid pump and a control pressure switch actuated by the pump discharge head pressure. When the feedwater pump is delivering water to the boiler, the pressure is imparted to the diaphragm of the pressure switch, thereby causing the electrical contacts to close and start the acid pump motor.

"It is, of course, obvious that the acid will be delivered to the feedwater at an almost constant rate, but only while the feedwater pump is working. This delivery rate could be adjusted to a minimum by making the acid discharge line very small and also by terminating discharge pipe in the feedwater tank with a spray nozzle or head. A check valve should be placed in the acid discharge line to prevent the possibility of the feedwater backing up or diffusing into the acid line through the acid pump."

The scheme proposed by Walter Heidecker of Chicago, Ill., is shown in Fig. 10. He partially dilutes the acid in the 200 gal tank which is installed on the floor above the storage tank and regulates the stroke of valve (1) by adjusting the turnbuckle (5) and by using different holes in the regulator arms. Valve (1) is installed in such a way that it opens when the arm is raised. The manufacturer of the softener should know about the concentration of H_2SO_4, usually about 2 per cent. Chemical tests should be run hourly until setting is determined. The change in pressure on valve (1), caused by the lowering of the level in the tank, is overcome by increasing the head by placing the tank on the floor above. The mixing tank, says Mr. Heidecker, should be large enough so that it would have to be filled only once in 8 hr.

A float, proposed by W. R. Ray of Canton, Ohio, is very interesting. This, as shown in Fig. 11, is made in the shape of an open ended can. Bushings are placed in holes in this can, one in the bottom and one in the side for overflow. A bushing or sleeve also is placed in side of acid tank near bottom. The overflow in float is connected to one in bottom by flexible tubing to pinch cock supplied at this point for regulation. Another length of tubing (flexible) connects bottom of float to sleeve through side of acid tank near bottom. This then is led to point near bottom of open storage and mixing tank. The acid tank is then filled and weights placed in float can to bring overflow (so-called) down to level or below depending on amount of feed. Final regulation can then be obtained by pinch cock. As acid level recedes in tank the head will remain constant at feed outlet as the head will not be dependent upon level in acid tank but predetermined and constant as controlled by weights.

It is curious to note the many different ways in which various people think of a problem of this kind. Consider the plan suggested by Hollis Osborne of Antioch, Cal., for example. This is shown in Fig. 12. Quoting from Mr. Hollis's letter,

"I would erect two tanks of about 80 to 100 gal on top of hot well or mixing tank. One tank is to receive softened water, and the other to feed out sulphuric acid into hot well or mixing tank.

"A float is installed into the fresh water tank, fastened to a cable that runs over on two pulleys to the sulphuric

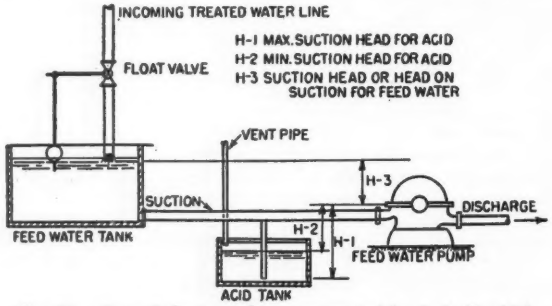


Fig. 9A. One of the two schemes suggested by J. A. Kendrick

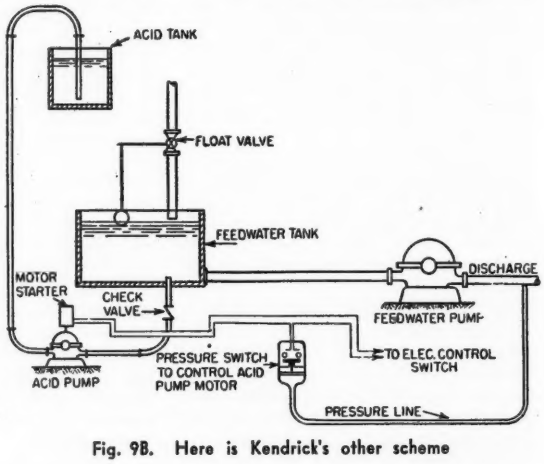


Fig. 9B. Here is Kendrick's other scheme

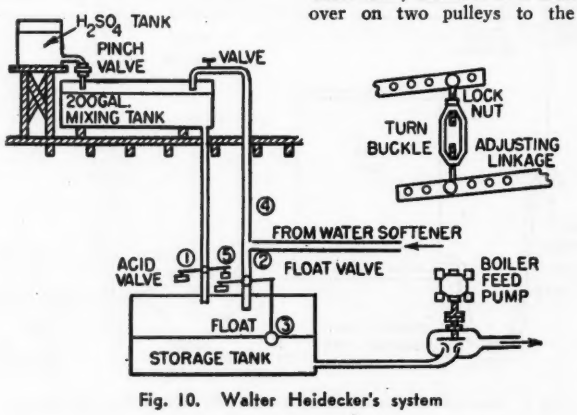


Fig. 10. Walter Heidecker's system

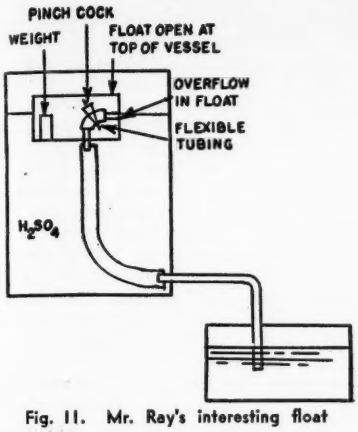


Fig. 11. Mr. Ray's interesting float

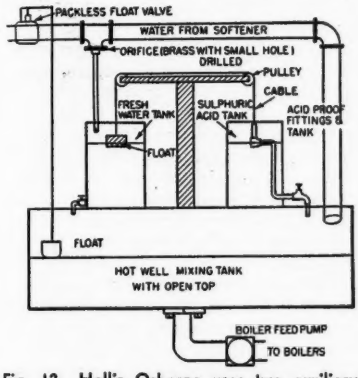


Fig. 12. Hollis Osborne uses two auxiliary tanks in this manner

tank at the end of which is fastened a tee and a hollow tube which will off-set the weight of the float in the fresh water tank. This tee has a flexible hose connected to it, and also to a fitting at the bottom of sulphuric acid tank.

"The softened water line has a float feed valve that regulates the amount of feed going into the hot well. Just beyond the float valve on discharge side, is an orifice consisting of a brass plate with a drilled hole. The water passing over the orifice regulates the amount of water that goes into the fresh water tank; as the float raises it will lower the tee and tube in the sulphuric acid tank and will cause the acid to run through the hose connection into the hot well below."

Now, we come to the solution of R. J. Osborn of St. Louis, Mo. We will not comment on the practicability of Mr. Osborn's system or the problem that might be involved in putting it into operation, but for sheer ingenuity and boldness of conception, this system deserves something more than mere honorable mention. It is shown in Fig. 13.

"In this system the sulphuric acid tank is set on top of the water tank. The weighted float has a slight distance to descend before the lower pin o in the stick u is pulled far enough against the stick v to cause the latter to rotate in a counter-clockwise direction on the pin p (by the spring as shown). This in turn strikes against the pin in the stem of the one diaphragm valve admitting water to tank, and the pin in the stem of the other valve in the pipe to the boiler feed pump. The former is immediately opened to full capacity and the latter closed from full open. When the tank is full, the raised float, through the linkage, reverses the valves from full open to closed and vice versa by the reverse trigger-like rotation of the stick v in a clockwise direction.

"By closing off the feedwater while the tank is being refilled a measured amount of sulphuric acid is added to a measured amount of incoming water as determined by the limits of the float movement.

"The sulphuric acid is added as follows:—The full can on the outside of the sulphuric tank holds the amount to be added for each refilling of the water tank. As the float rises, the hinged piece d on the vertical stick a raises the weighted lever b which is pivoted at c. This unpinches the rubber tubing e and the sulphuric acid in the full can empties into the water tank, the acid being well mixed by the turbulence created by the incoming replenishing water. The acid can is vented by the small diameter vent tube n.

"Filling of sulphuric acid can:—After the sulphuric acid can has emptied, the hinged part d of a slides off the lever b which then returns to its former position and closes the can outlet. As the float continues to rise, the cross stick s pushes the lever h upward raising the weighted stick i which slides in the grooves j on the side of the sulphuric acid tank. The can g fills as the raising of i unpinches the rubber tubing k which leads from the sulphuric acid tank to the can g. When the float again descends this opening is closed off again."

Further General Comment

It is not feasible to present all the solutions or even to comment on more than a few besides those already presented. Many of the more or less regular contestants to this department sent in good solutions. Our friend Julian Calvert for example submitted a solution involving a spring-loaded regulating valve in the line from the acid tank to the mixing tank. The operation of this valve is controlled by the pressure differential across an orifice in the softened water supply leading to the mixing tank. His system further makes use of a small auxiliary acid tank between the main acid tank and the mixing tank. The acid level in this auxiliary tank is float controlled.

Lewis G. Coscia, mechanical engineer of Baltimore, Md., suggested a system also using an auxiliary acid tank but in his case the flow of acid from this tank is controlled by an eductor operated from the softened water line.

Herman Krause of Flushing, N. Y., submitted two schemes, both incorporating regulating valves in both the acid feed line and the supply line from the softener and both controlled from a single float in the mixing tank by means of compound levers.

Raymond J. Braski of Chicago, Ill., used two floats in the mixing tank, one controlling the flow in the softener line and the other the flow of acid from the acid tank.

Joseph M. Pauly of Toledo, Ohio, suggested a separate auxiliary acid and water mixing tank between the main acid tank and the mixing tank. The levels in both this auxiliary tank and the main mixing tank are controlled by floats so that the water and acid level tends to be slightly higher than the level in the main mixing tank. The auxiliary mixing tank has a slot cut in one side so that the water-acid mixture flows into the main mixing tank.

Arthur J. Wenig of Brooklyn, N. Y., proposed the use of a Wilson (or similar) "Pulsafeeder." His arrangement is shown in Fig. 14. This type of machine, he says, can handle any liquid as its pump parts are made of glass. It can be adjusted to feed from one drop per minute to several gallons per minute. A

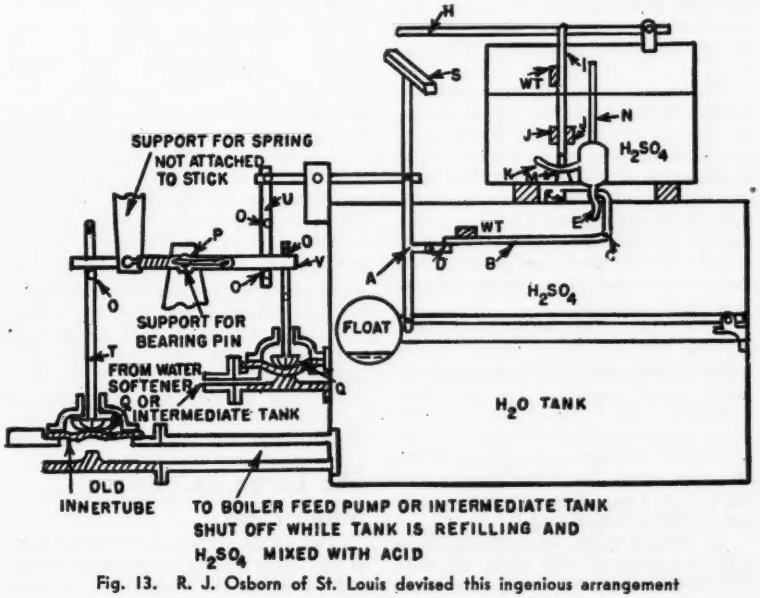

SUPPORT FOR SPRING NOT ATTACHED TO STICK
SUPPORT FOR BEARING PIN
FROM WATER SOFTENER OR INTERMEDIATE TANK
FLOAT
H_2SO_4
H_2O TANK
OLD INNERTUBE
TO BOILER FEED PUMP OR INTERMEDIATE TANK
SHUT OFF WHILE TANK IS REFILLING AND H_2SO_4 MIXED WITH ACID

Fig. 13. R. J. Osborn of St. Louis devised this ingenious arrangement

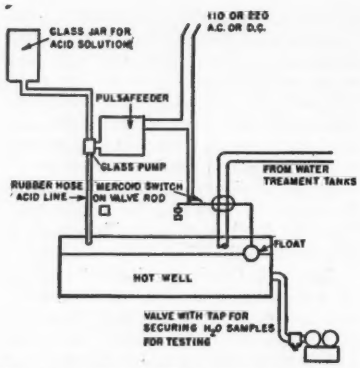


Fig. 14. Arthur J. Wenig suggests the use of a "Pulsafeeder"

Mercoid switch is fastened to the float rod so that when the valve opens the Mercoid bulb will tilt and start up the Pulsafeeder.

In closing, honorable mention is also awarded to the following for sending in good solutions:

Archie C. Camp, Honolulu, T. H.
Elmer H. Giese, Peoria, Ill.
Owen W. Baker, Peoria Heights, Ill.
W. J. Wright, St. Louis, Mo.

LETTERS AND COMMENTS

Further Opinion Regarding the Small Plant

I CAN SYMPATHIZE with Pvt. Green in his feelings regarding the small plant operator and their outmoded equipment. But after working around plants of this type for 14 odd yr, I realize that it is difficult to do very much about the situation.

The majority of such plants are ancient simply because the chief engineers also are ancient. In many instances, of course, the trouble is that the companies do not make a practice of building up a surplus with which to replace worn out and obsolete equipment. If large corporations can set aside millions of dollars a year for improvements, small plants could do likewise. The government permits plants to do that.

I know of a plant where they burned out one fair size motor about once a month. In this plant there were no automatic circuit breakers on the main switchboard, no overload relays, in fact no protective equipment of any kind except a few old crystallized fuses. What this plant spent for motor repairs during a year, I would not venture to guess but it was a sizable sum.

In another plant, where the combustion chambers are only about one-third the proper size, they could save about $5000 a yr by throwing out an old steam engine and buying their electric power. In another plant, the Hrt boilers are delivering only about 4 lb of steam to a lb of coal and where thousands of lb of steam are wasted through leaks of all kinds and wasted condensate.

Yet, these plants continue operating. If such conditions existed in more progressive organizations, the chief would last only long enough to find his hat and get out. There is no valid reason why a small plant need operate without flow meters, simple automatic combustion control, water-tube boilers, turbogenerators or uniflow engines, etc. If this type of equipment is so worthwhile in large plants, it can save money in the small plant.

So, let's kick about the old equipment instead of defending it and trying to keep it running. Also, if young engineers learn more, they will be worth more to their employers and get paid more. Let us get paid for what we know, not for what our fathers knew.

Parma, Ohio — M. J. S.

The Large vs. the Small Plant

THE SMALL PLANT is just as important as the large one in every way, shape, and form but the reason why it does not find its way into the headlines of the power plant magazines is because the small plant is composed of equipment of conventional design and features that seldom change. While it is true that the small plant operator has his problems and in a great many cases more so than the large plant operator, his problems still are of a conventional nature—problems that can be solved by the average engineer. The large plant operator does not solve his problems. The company that produced the machinery does the solving. The small plant operator is in many cases under paid and does not take the interest that he should. Furthermore, nothing ever happens in the small plant that amounts to anything or is worth writing about or that has not been written about over and over again. So the operator loses interest.

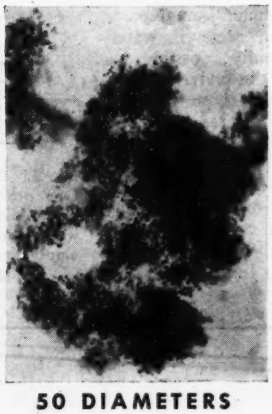
In the large plant, new experiments are conducted on large, modern equipment and all eyes are anxious to see the outcome. New machinery of the latest type is constantly being placed in service. In many cases the equipment or device is the only one in the state or city and all eyes are again focused on the outcome. The large companies have a large investment at stake in their power houses, investments that often run into the tens of millions of dollars and everything must run like clock work. Everything that is needed is gotten and always the very best that money can buy.

Before we can attempt to really compare the large and small plant, we must know where the small plant begins and ends. What pressure or horsepower separate the two from each other? For sake of argument we may say that anything under 250 lb pressure and under 2500 hp is considered a small plant. The small plant is composed of equipment of conventional design of comparatively low pressure and free from elaborate and complicated controls and operation. This type of equipment is covered in the pages of every textbook and is as common to the average engineer as the Ford car. The problems and operations are substantially the same everywhere you go.

When an engineer takes charge of a small plant, he is given time to learn the pipe lines and valves and is expected to know the rest from previous experience. Take the company that I work for as an example. We have three steam producing plants. The one I am in now, has three 525 hp B.&W. boilers built in 1921. These are fired with Taylor underfeed stokers built in 1920. These boilers are equipped with Brookes Engineering stoker and damper controls. We have turbine driven forced draft and induced draft fans with electric drives for emergency; direct acting duplex steam pumps for boiler feeding. The other plant has three boilers, one a Scotch Marine about 325 hp, another a Heine 350 hp. The third is a Cleaver-Brooks oil-built. The first two are fired with steam atomized burners and the oil-built has a mechanical burner. This plant has direct acting duplex steam pumps and an open feedwater heater.

IN A GLASS BOILER

50 DIAMETERS
Actual boiler water treated with common chemical but uncoagulated.



50 DIAMETERS
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The third plant is a waste heat plant. Sulphur is burnt in a burner. The gases of combustion are passed through waste heat boilers, designed by Foster-Wheeler Co. After leaving the boilers the gases go on to make sulphuric acid. Two of these boilers operate at 185 lb pressure and two at 235 lb. The B.&W. plant operates at 145 lb and the oil burning plant at 120. The waste heat plant has direct acting duplex, outside packed plunger pumps for feeding. Elgin softeners are also included. This plant leans toward the large plant side as far as operation is concerned but totals only about 1000 hp.

These plants contain nothing that is unusual or difficult to operate. The large plant usually develops its own men so to speak. The men just grow up with the plant from oilers or firemen. The ever changing program of design and pressure conditions of the larger plants keep the public attention while the older plants have nothing interesting to offer.

Baltimore, Md. CHARLES W. PARKS

Here's an Idea for a High Voltage d-c Generator

IT HAS BEEN said that fools rush in where angels fear to tread. Not being equipped with wings, the writer, naturally, falls into the first category. So—

The possibilities of high voltage direct current transmission are most intriguing, especially to those who have been privileged to inspect the one commercial installation of this type of transmission in the country.[1] It does seem, however, that if the complexities and costs of a huge electron tube bank at each generating station could be eliminated at least in part, the future of this type of transmission would be brighter.

It is obvious that a d-c generator is needed but we all know that the difficulties of commutation are limiting factors in the operation of high voltage d-c generators; so, if we could do away with mechanical commutation, it might be possible to design and operate a true high voltage, high capacity d-c generator.

For central station use, the machine would be large and it would, of necessity, have to have a stationary armature and a revolving field. Thinking along these lines, it has occurred to me that it might be possible to supply the fields from an alternating current source through electron tube rectifiers. It would be necessary to effect a reversal of the field current at the instant the poles were passing through the neutral plane between the armature coils. Thus, although the fields themselves reverse polarity, they would induce in the armature a current in one direction since they would always present a uniform polarity with respect to the individual armature coils. Extremely accurate mechanical and electrical timing would be imperative and I have ideas as to how this might be accomplished. I understand that wave forms of any desired shape can be produced by an electron tube, so a relatively efficient form of "Ripple" would be practical. This could further be ironed out with reactors.

Maybe this idea is wacky.

W. S.

EDITOR'S NOTE. *W.S.'s idea, it seems, is to time the position and the direction of the current in the field coils so that they will induce a pulsating current in the armature. It should be clearly understood, however, that a pulsating direct current in one winding of a transformer or induction coil will produce an alternating current in the secondary. Just how the idea might be worked out would require considerable ingenuity. What do other readers think of the suggestion?*

[1] This is the 17 mile 17,000 v direct current transmission line between the Mechanicsville, N. Y., hydro plant of the New York Power & Light Corp. and the General Electric plant at Schenectady, N. Y. As the system stands today, it receives the available output of the Mechanicsville hydro plant at 12,000 v, 3 phase, 40 cycles, rectifies that power to direct current at 17,000 v at which voltage it is transmitted the 17 miles between Mechanicsville and the Schenectady substation, where it is inverted to 13,200 v, 3 phase, 60 cycles and then delivered to the busbars at the General Electric mercury turbine plant. This line dates back to October 1935 when it was first started as a joint enterprise of the N. Y. Power & Light Corp. and the G. E. Co. Originally, the rectifiers and inverters used hot cathode tubes but now, mercury pool tubes of the ignitron type are used. Ed.

A Problem in Hydraulics

IT IS MY wish first to express appreciation for the many interesting articles that appear in your publication. No doubt every reader has an interesting situation crop up occasionally in his own bailiwick and if my conception of readability is anywhere near right, it is the discussion, provoking thought, as well as the authoritative article, which really makes it so.

In my work, having to do with hydraulics and power generation, a subject pertaining to the design and performance of air valves placed at intervals along a wooden pressure line terminating in a steel penstock, has recently been the topic of discussion among the laity in our group.

It is freely admitted that the purpose is to admit air to prevent line collapse in event the water column should part. This conceivably might occur if water is drawn out too rapidly; possibly by line rupture. Also, the valve should close rather gently—at least, not too violently—when pressure is resumed, say while filling the line.

Specifically, the speculation has to do with the placing of springs, either in combination, singly, or complete elimination thereof, to get correct valve action.

It happens that this line was recently re-built. For reasons of economy, the old hoops and air valves were used again; but for safety, thicker staves were used. Discussion tends to bring out the possibility of more pipe line friction for a given load when contrasted with performance of the old line.

The accompanying drawings are presented for the sake of clarity. Also the figures showing the static head at two points, together with the corresponding pressure, are given. The weight of the air valve plunger is around 20 lb.

One group inclines to the plan of placing a flexible spring at point "A" (Fig. 2) so that the valve will balance about one inch from the seat on an empty line, claiming no violent action during closing of the valve, which is expected to actuate with each surge, until pressure is sufficient to keep it closed.

Another group would place a spring at "B" to cushion the action. Still others would use both springs and still others would graduate the strength of springs used only at "B" according to the gradient of the line.

There is still another group which would check pressure on the valves under full load. If they could do it in no other way, they would look down the surge chamber and get an idea of what pressure might be on the valves from that; and if several feet were apparent, they would forget everything except to use care in the filling of the line.

What say you?

El Portal, Cal. HOMER H. CRIDER

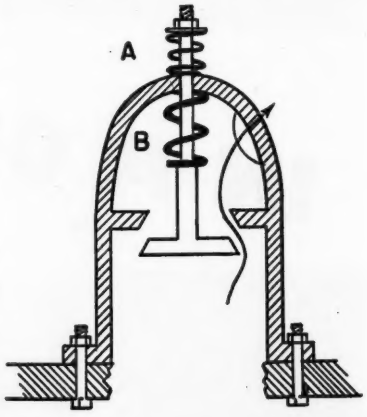

Fig. 2. Details of the proposed relief valve. One group suggests the use of a flexible spring placed at point A so that the valve will balance about 1 in. from the seat on an empty line. Another group would place a spring at B to cushion the action

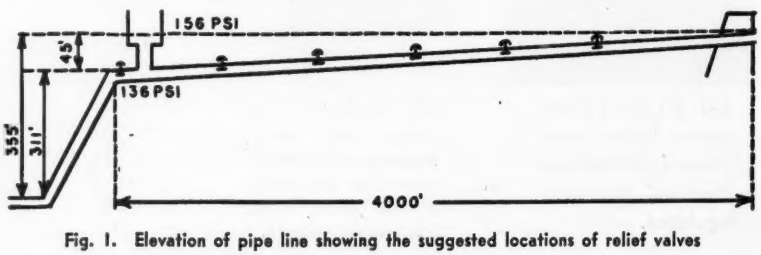

Fig. 1. Elevation of pipe line showing the suggested locations of relief valves

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Questions And Answers

Question No. 262

How Connect Single-phase Wattmeters to Measure Two Parallel Generators?

IF I HAVE two 3-phase alternating-current generators operating in parallel, can I use one single-phase indicating wattmeter in each generator circuit to measure the power output of its individual generator? If so, would it measure load correctly on a single phase or would the indication have to be multiplied?

Topeka, Kans. C. R. D.

Question No. 263

Why Forbid Flax Packing on Water End of Pump?

I AM A BIT PUZZLED by a notice that has just been posted on the bulletin board in the power plant where I am a watch engineer. The notice states that "from now on, flax packing shall *not* be used on the water ends of boiler feed pumps; use *only* steam packing on the water ends." These are reciprocating pumps.

Now in my early years I was always taught that flax packing was the thing to use on the water end of a reciprocating pump and all my subsequent experience has confirmed this, in general. But in this particular case I have heard that somebody connects the use of flax packing with an epidemic of stuffing box gland breakage and packing nut breakage we had some time ago. This occurred on both water and steam ends. However, we have installed new stuffing boxes complete on all the pumps and since then have had no more gland breakages.

As I see the matter, the flax packing had nothing to do with the packing nut or gland breakages. If the flax was the cause of the breakages, why did we have the same trouble with breakages on the steam ends of the pumps where regular steam packing was installed?

I still maintain that flax is a very good packing for pump water ends. But I know that strange things sometimes happen in power plant equipment. I wonder if other readers of Q. & A. have ever encountered a matter of this nature. If so, I'd like to have your ideas. How many engineers still use flax packing on water ends of pumps?

I might say that we have plenty of flax packing in the locker and know where we can get more, so the above rule apparently has nothing to do with priorities or difficulty in getting the flax.

In short, what is the engineering reason, if any, behind the above rule forbidding flax packing? Is there any possible connection between the use of flax packing and the pump gland breakages, or is this whole thing decided on some other basis than engineering?

Philadelphia, Pa. S. J. A.

Question No. 264

What Causes Stoker to Smoke and Gas from Hopper?

CAN YOU TELL ME how to overcome the almost constant smoking and discharge of gas from the hopper on one of our two underfeed stokers? This smoke and gas come out through the top of the hopper and also at the joint between the hopper and the stoker mechanism.

For years both of these stokers operated well, with only intermittent smoking and gassing for short intervals. Finally, however, we found the coal channel plates and shoes on one stoker getting badly worn, the pushers weren't working right and the stoker was in bad condition, so we sent it out and had it completely overhauled and put back.

Before the overhaul, the stoker was so bad it was sluggish, and was actually crushing the coal in the channels before pushing it up into the retorts. But now, with the stoker in good shape, the coal, which is 1½ in. nut and slack, comes out in the retort in just the same condition it goes into the hopper. So far as I can see, the stoker itself is working very well now.

But this continual smoking and gassing through the hopper is very bad. Is it due to poor or unsuitable coal or improper alignment of stoker or grates? If we cut off the forced draft blower, that seems to help a lot. But then we're not getting sufficient steam. The dampers are O.K.

I am in charge of maintenance and am very anxious to cure this trouble, because the other engineers all give contradictory explanations of it and can't seem to stop it.

Philadelphia, Pa. E. K.

May Be Deficiency of Draft

THERE ARE a number of factors which might cause such smoking, but with the meager information given it is difficult to make a satisfactory diagnosis. However, since E. K. says that smoking is reduced when the forced draft is cut off, there is a strong possibility that, with the increased combustion rate when the fan is running, the chimney (or induced draft) is insufficient to carry away the products of combustion. Smoke and gases, therefore, are forced out through the coal hopper.

This deficiency of draft may be due to various causes, such as numerous leaks in the setting, damper not opening or the chimney not high enough to overcome the resistance of the system. E. K. doesn't say whether there had been any changes in the baffling at the time the stoker was re-installed, or whether any other equipment such as an economizer or air heater was added. Unless the draft is sufficient to produce a slight negative reading for draft above the fire when the forced draft fan is turned on, the induced draft, whether it is produced by a chimney or a fan, should be carefully checked.

Years ago, when trouble shooting for a stoker company, I was called to a plant where a new stoker had just been installed. Due to sudden illness the stoker erector had to leave before he could get the stoker fired.

Plant operators tried to put the boiler on the line but found that the stoker smoked so badly through the hopper and around the front of the setting that they couldn't get up steam. It should have been obvious, even to the plant bookkeeper, that something was wrong with the chimney draft, although it was apparent that the chimney itself was not at fault since it was about 200 ft high. Draft readings taken at various points in the setting showed practically no draft even as far back as the damper. Proceeding further back into the breeching between the boiler and chimney, I found to my amazement that the structural steel workers had neglected to install the top plate in one section about 4 ft wide by 8 ft long. This huge opening was by-passing all of the draft to the boiler.

Other causes of smoking might be (a) coal particles too large, (b) coal too dry, (c) burning characteristics of coal too great for present furnace design, (d) irregular or uncoordinated action of rams and bars causing nonuniformity of fuel bed or caking of fuel, (e) insufficient forced draft pressure or improper air distribution.

As to the proper action of the main feeding and distributing rams, the description of a Taylor stoker, given in the Cochrane Corp. Handbook (1928), entitled "Finding and Stopping Waste in Modern Boiler Rooms," should give E. K. a general conception of the entire operation.

Without actually observing conditions, it is almost impossible for a trouble-shooter to prescribe any remedy, but it would appear that draft conditions should be investigated first.

Naperville, Ill. J. R. DARNELL

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DESIGN DETAILS

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DIMENSIONS AND RATINGS

4000 lb at 150 F
600 lb at 750 F — 475 lb at 1000 F

DIMENSIONAL DETAILS

SIZE	⅛"	¼"	⅜"	½"
End to end—Globe	1 13/16	1 13/16	2¼	2¾
Center to end—Angle	29/32	29/32	1⅛	1⅜
Center to top—Open	3⅝	3⅝	3⅞	4
Port diameter	⅛	3/16	¼	⅜
Weight—lb	1	1	1¼	1½

For illustrations, dimensions and descriptions of the Edward line of cast and forged steel valves write for a free copy of the new Edward BETTER VALVES Catalog No. 102.

THE EDWARD VALVE & MFG. CO., INC., • EAST CHICAGO, INDIANA

EDWARD *Steel* VALVES

Answer No. 250

How Stop Fuel Waste in This Unit Heater System?

As JIMMY DURANTE says, "Everybuddy wantsta get inta the act!" Interest in this problem continues unabated, for obvious reasons. Is there a power engineer who has not had at some time, or does not now have, supervision over some kind of heating system?

H. E. S., you remember, wants suggestions for the best things to do in a unit heater system, described in detail in the February 1944 issue, to prevent a serious fuel waste. This results from frequent blowing down of boilers, required because returns from the unit heaters operating at 75-100 psi come back to vacuum pumps so hot that large amounts of cold water have to be fed into the condensate return lines, thus producing a great excess of boiler feedwater. Also, the pumps have trouble handling the hot condensate.

Many interesting suggestions for preventing or remedying the trouble were published in the March, April and May issues.

Use of Return Traps Advocated

IN ANSWER to Question No. 250, where precious heat units are lost due to the inability of pumps to handle the condensate, I would recommend the use of return traps of the Morehead or similar types.

This type of return trap can be used in all places where a pump would apply, except it has no suction power, therefore arrangements must be made for a gravity or pressure supply to the trap. It will handle water at any temperature, however hot, and performs the same mechanical work as a pump on much less steam consumption, generally not to exceed 10 to 20 per cent—practically equivalent in volume to the water handled.

At the cotton mill here, the condensate of all machines, as well as heating circulation returns, flow to this type of return trap in a vault in the lowest part of the plant. This return trap discharges to a similar trap mounted 6 ft over the high water mark in the boilers, which the condensate enters through the blow-off pipe. These traps rarely need more than one overhauling during a season. All heat units in the condensate are thus returned to the boilers automatically and at a much greater economy of power than by hot wells and pumps.

Blackstone, Mass. FRED M. BENNETT

Martin Shows How To Make It Work

I WOULD suggest that H. E. S. install pump governors and water level controllers. Many benefits and peace of mind may be derived with their use. For instance there is less tendency to neck-craning at the gage glass; less wearing out of shoe leather to and from the feed pumps; no blowdown of boilers, except when needed, as concentration readings show; a better firing rate tending towards an even steam flow line on chart; a saving of fuel; less water used; stresses and strains on the boilers at a minimum; scale formation controlled by keeping the boiler load as even as possible, instead of alternate cooling and heating of water in the steam generators; boiler settings last longer and require less cleaning and repair; the crew will find time to take care of other vital equipment and keep their plant in A-1 shape.

If H. E. S. can make changes in the trap installations, he would benefit by the installation of pressure reducing valves on the mains in the boiler room; or if the building is large, or buildings are scattered over a large area, the reducing valves may be installed at a remote point. Steam flow meters should be installed also, on the different branches of steam piping, if there are several buildings to be heated. From 1 to 3 psi steam pressure is sufficient to carry on the heating system, although some plants carry from 2 to 14 psi and higher.

There is a condensate return pump that goes under the name of Adsco-Becker (American District Steam Co.) but I have reason to believe there is now such a pump called the Cochrane-Becker. This type of pump may take its suction from a set of traps discharging into a common return header.

One installation of this pump with which I am familiar is shown in the attached sketch.

Packing used on the condensate return pump is of the metallic, copper spun type, but caution must be exercised in using the right kind of metallic packing. There is also a water-seal for the packing on this type of pump. Discharge temperature for this pump was 345 F.

Valves on return lines, prior to entering the flash tank, were adjusted from 2 turns to 3 turns, depending on the temperature readings taken on equipment with a portable pyrometer. Whenever a unit was installed (that is added to the plant process) we would check the heat balance for several different days and loads.

H. E. S. should keep the boiler plant auxiliaries operating with full boiler pressure, reduce the steam pressure for heating if he is going to use the vacuum pumps, and have a reading on the vacuum gage from 2 to 5 in. This low vacuum reading of 2 in. may be maintained if the vacuum system is tight. If the system isn't tight, vacuum readings will be considerably higher due to the speeding up of the vacuum pump.

However, if H. E. S. still wants to use high pressure steam for heating, he may utilize the condensate return pump with beneficial results. If low pressure steam heating were used, the present vacuum pumps will serve their purpose and no return pump would be needed.

Automatic steam control of the vacuum pumps should be maintained from the suction side. The steam valve has a diaphragm, which is actuated by the vacuum, which in turn operates the stem of the steam valve.

High-pressure traps should be given a periodic inspection. A quick way to check a trap is just to listen to it; any serious blowby will be quickly detected.

I believe that one of the reasons H. E. S. doesn't care to put the heating load on low pressure is that there may be too much trouble changing the trap installations, so that they may operate on low pressure. However, if he can obtain a condensate return pump, either new or used (there goes your priority number again), he wouldn't need the vacuum pump.

I suggest that the exhaust steam from the feed pumps would be hooked up with the preheat tank, but an oil trap should be used with a sight glass, and another steam trap after the oil trap, just before the steam exhausts into the pre-heater.

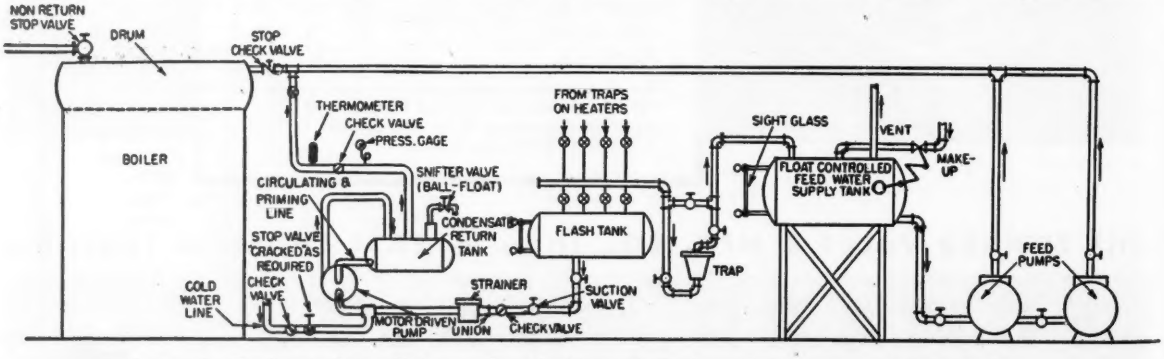
The feedwater should be heated to a temperature of 212 F to 215 F.

Fairview, N. J. MARTIN N. GOZDENOVICH

Answer No. 252

What Will Happen to the Megavars—and Why?

IN THE March issue, R. F. L. asked what would happen, when a generator and a synchronous condenser equipped with a voltage regulator are connected to the same bus and the field strength of the



Design of a Condensate Return System as shown by Martin N. Gozdenovich, to overcome H. E. S.'s troubles

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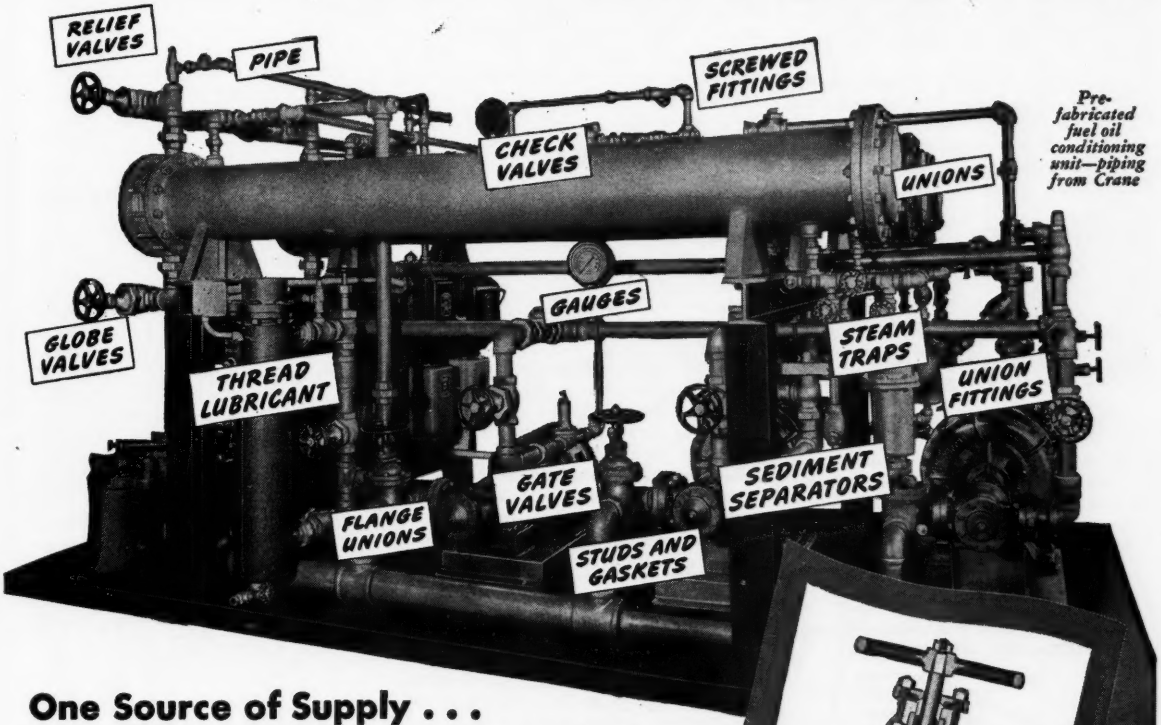

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generator is adjusted to make the generator reactive kva leading instead of lagging. What would happen to the reactive kva or megavars of the synchronous condenser? Would it increase, decrease or remain the same?

Leading Reactive Kva on Condenser Will Increase, Says Amole

I BELIEVE that R.F.L. will see an increase in his leading megavar readings on his condenser if he makes the reactive on his generator leading instead of lagging.

Assuming a connected load on the bus of a certain power factor, this load characteristic is determined by the customers, and is not changed by varying the reactive kva on generator or condenser. This is shown in Fig. 1.

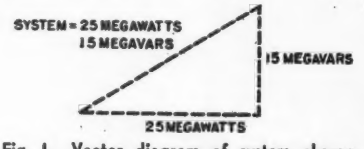


Fig. 1. Vector diagram of system characteristics, determined by consumers of power

Now assume that the generator supplies the system megawatts, plus say 1 megawatt for driving the condenser, or 26 megawatts. Assume it also carries 10 megavars lagging and the condenser 5 megavars leading. Then the situation would be as shown in Fig. 2. Now, reducing generator excitation will tend to reduce bus voltage, and the regulator on the condenser will increase the condenser excitation to maintain voltage, resulting in increased leading reactive on the condenser. This is illustrated by Fig. 3. However, I do not advise R. F. L. to operate his generator with such a weak field that will result in leading reactive on the generator for it will be very unstable and a slight system disturbance may result in demagnetizing its already weakened field to such an extent that the generator will fall out of step and severe surging will occur.

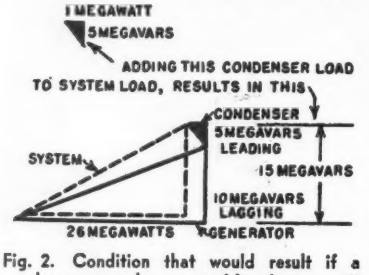


Fig. 2. Condition that would result if a synchronous condenser requiring 1 megawatt to drive it and producing 5 megavars leading, is added to system load

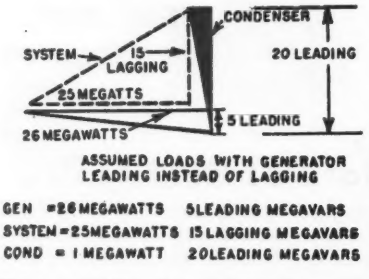


Fig. 3. Condition that would result in system of Fig. 2. if generator megavars become leading instead of lagging, through decrease of generator field excitation

If R. F. L. really wants to know the answer, he can increase the excitation on the generator and then the leading reactive kva on the condenser should decrease. Then decrease the generator excitation to normal; as a result the leading reactive kva on the condenser should increase.

Norristown, Pa. EDWARD J. AMOLE

Megavar Load Will Increase, Says Pride

THE MEGAVAR load of the condenser will increase as the generator field excitation is reduced. Changing the generator from lagging to leading power factor will lower the output voltage of the generator and the megavar load of the condenser will increase as the voltage regulator loads it up to maintain proper bus voltage.

R. F. L. says the reactive on the generator is, of course, lagging. Why? Assuming the condenser to be large enough to carry the reactive load, the generator should be operated at unity power factor. When the power factor is lagging, unnecessary heat is generated in the coils and when it is leading, there is danger of low voltage when the load increases suddenly.

Decatur, Ill. G. C. PRIDE

Condenser Current Will Increase

REDUCING the strength of a generator field, operating in parallel with a synchronous condenser or other synchronous machine, will result in a decrease of reactive kva on the generator or an increase of current in the condenser.

If the reactive kva of the generator is large, compared to the capacity of the condenser, the condenser may be overloaded or worked to its limit. Some condensers are furnished with exciters that will not generate more than sufficient voltage to supply normal current to the rotor to sustain normal load. Regulator settings, field or exciter rheostat adjustments, and overload relays should be considered here also.

Reducing generator field strength past unity is both uneconomical and unsafe. A power factor of about 70 lagging combines the most active and reactive current to give the least resultant current or heating effect of the generator, assuming you can control the division of currents. Low field strength may allow the generator to drop out of step, which makes conditions in the generator about the same as if the system were short circuited.

If the capacity of the condenser is such that it will be limited to a value of current less than that dropped by the generator, then the bus voltage will drop, and have a stabilizing effect, to a limited degree. A lower voltage will also reduce the system megavars.

Reactive or magnetizing current is a result of system or load conditions. Generator frequency and voltage will affect the amount of the current. If they are constant, then we have to have the megavars on either the generator or the condenser. The amount on each will be determined by the relative voltage, if there is little resistance or inductance between the two machines.

It would be interesting to know why the regulator was put on the condenser instead of the generator, unless the condenser is on the end of a long line and intended to compensate for line drop, during some part of the time.

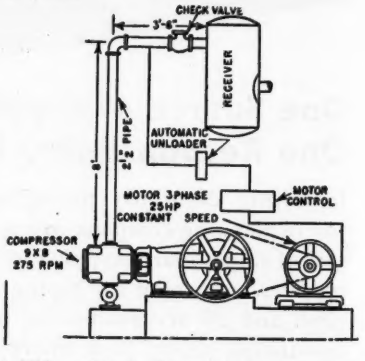
This question can be made a very long story. I hope I picked the angle R. F. L. is interested in.

Akron, Ohio. J. WEDDELL

Answer No. 254

Church Bell in Compressor Discharge—Bats in Engineer's Belfry

IN THE MARCH ISSUE, A.J.K. gave the details of a compressor installation in which a check valve was installed as shown in the accompanying sketch. The compressor starts and stops frequently, he said, and that check valve goes "bong!" like a church bell and makes such a racket that it is slowly but surely driving him nuts. How can the situation be remedied, he asked, pointing out that if the check valve is taken out, the compressor starts against load and throws a terrific strain on the belt, which he wants to avoid.



A.J.K.'s original diagram of compressor hook-up, showing valve that slams

Now, to begin with, we told A.J.K. that the simplest solution would be to install one of the various types of silent or non-slamming check valves supplied by various valve manufacturing companies. But A.J.K. wrote right back and said that (1) he couldn't get the money to spend for one of these valves, (2) he was in a non-essential industry and couldn't get a high enough priority even if he had the money. That's why he wanted to see if anything else could be done.

By a curious coincidence (nobody will ever believe it wasn't planned—but it wasn't) A.J.K.'s original question appeared on a page directly opposite the advertisement showing the Edward check valve designed to cushion shock and reduce noise to a mini-

"ENEMY ROUTED"..

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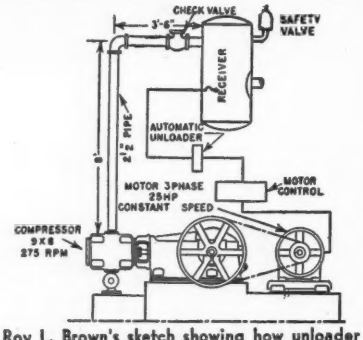
mum. Then there is the Williams-Hager silent air-check valve designed for just such applications, there is a Crane piston-type silent check valve and you can go right down the list—Kennedy, Powell, Chapman, Jenkins and a dozen others—and find just the check valve needed to cure this trouble. But A.J.K. can't do that, as he explained above.

Here are some of the ideas other engineers had.

Brown Would Change Unloader Connection

I DON'T UNDERSTAND just how A.J.K.'s pressure unloader worked with the connection ahead of the check valve, provided that the check didn't leak pressure. Maybe this difference in pressure might have something to do with his church bell effect. He doesn't give the difference in his gage pressure, so the fault cannot be traced too easily. The receiver pressure should not vary much over 10 lb before



Roy L. Brown's sketch showing how unloader should be connected to receiver instead of ahead of check valve

the unloader stops and starts the motor. There must be a great variation in pressure there somewhere to make the check valve go "bong!" for if the pressure were nearly equal on both sides there wouldn't be any fluctuation. I would reconnect the unloader as shown.

Sloat, Calif. ROY L. BROWN

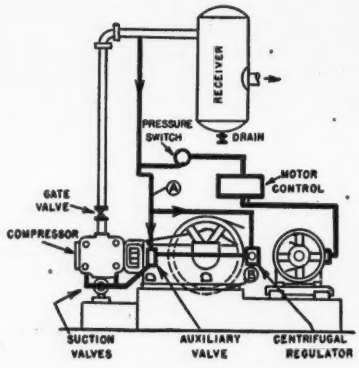
Dobson Redesigns Control Method

I RECOMMEND that A.J.K. take the check valve out entirely and install a gate valve in the discharge line close to the compressor cylinder. This gate valve is only for use when it is desired to examine the discharge valves of the compressor or other parts of the machine.

From A.J.K.'s drawing, I assume the automatic unloader is really a pressure switch cutting out the motor when the pressure is up to the required point. Sketch 1, herewith, shows how I would rearrange the hook-up.

The pressure line (A) on Sketch 1 should be connected to a spring-loaded unloader valve, which keeps the suction valves open on the cylinder and allows the piston to move backward and forward without any compression.

This valve is labeled "auxiliary valve" on Sketch 1 and can be set

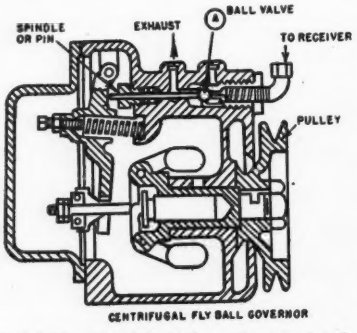


Sketch No. 1 by John Dobson showing how he would eliminate the check valve

to a pressure difference of say 10 lb; that is, when operating at 100 lb pressure, the suction valves remain open until the pressure has dropped to 90 lb, then they close and compression starts again until 100 lb is reached, then they open again.

This, however, means that the motor is in continuous operation but it is absorbing very little power when unloaded, except to overcome friction.

If you want to stop and start automatically, it will be necessary to equip the compressor with a centrifugal type regulator as shown at (B) on Sketch 1. This is driven by a small V-belt from the crank shaft pulley. Details of this regulator are shown in Sketch 2.



Sketch No. 2 by John Dobson showing details of centrifugal regulator

When the compressor is stopped or idle, the ball valve (A) in the regulator, Sketch 2, is pushed to the left, leaving the passage open from the receiver to the unloader valves, and the machine can be moved easily by hand. As soon as the compressor is started by the pressure switch on the motor and gradually comes up to speed, the fly balls move out, the spindle or pin and ball are pushed to the right then the passage from the unloader valves is open to the exhaust and the suction valves close, and compression starts in the cylinder until the required pressure is attained.

I have used this arrangement for the past 10 years with perfect operation.

Brooklyn, N. Y. JOHN DOBSON

Use a Balanced Check, Says Parks

THE CHECK VALVE should be used and, in most cases, is absolutely necessary, but the one shown in the sketch is the wrong type for this kind of work. A check valve for this kind of job should be a balanced check. Such a check valve is of the piston type, with a composition disc, on a flat seat. With this type of check valve, there is a 3/16 in. or ¼ in. copper tube running from the top of the valve to the unloading valve at the cut-off switch to the motor. This takes the place of the regular unloading line as usually run.

When the compressor stops or, in other words, when the flow of air stops, the check, being balanced—having the same pressure on both sides—falls closed by gravity. The line is then unloaded for the next start.

This is a very special valve and may not be available everywhere but is well worth the money if it can be obtained. The ones I know about are handled by Brunner Air Compressor Corp., Utica, N. Y.

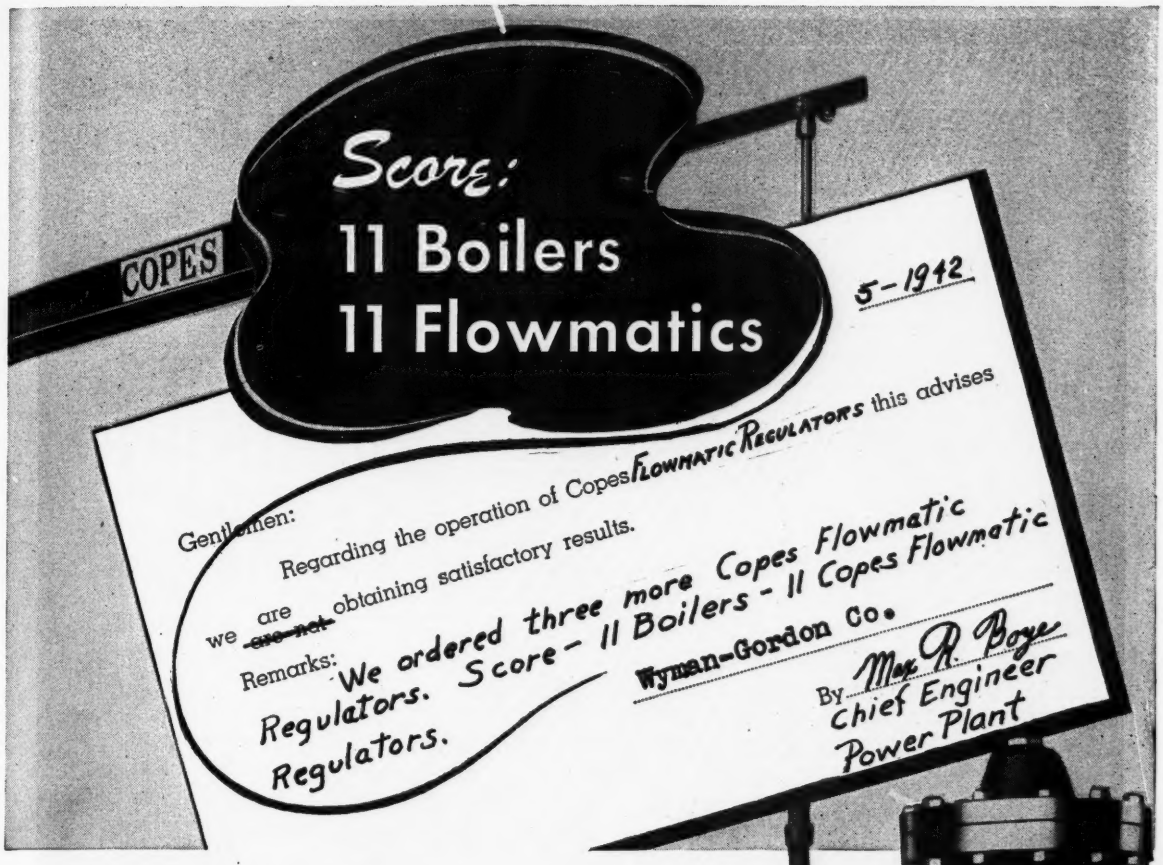
Referring to the sketch again, I believe that the situation could be improved by moving the unloading line closer to the compressor. With this method, the pressure drop will be farther away from the check and will give the check easier closing. Another good method is to use a magnetic valve of the type used on most automatic oil burners. This valve is used in place of the check and is hooked up to the cut-off switch by a link. When the cut-off switch is thrown, it moves the link, which operates the switch to the magnetic valve, closes the valve and the line is unloaded behind it. This has to be hooked up to suit the job but is an easy matter for any electrician.

Baltimore, Md. CHAS. W. PARKS

He Has Pauly's Sympathy—and Help

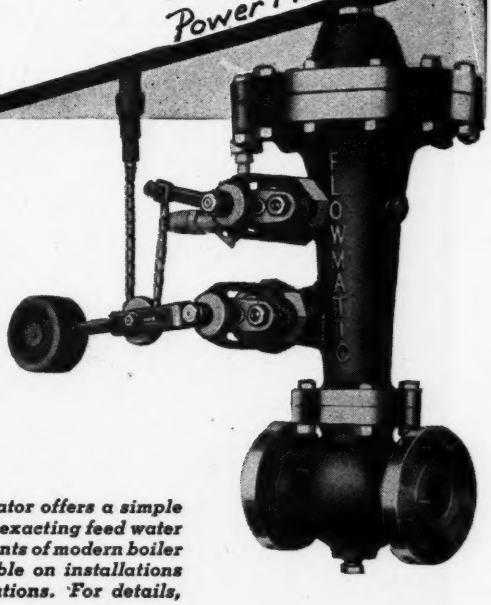
IN REGARD to A.J.K.'s troubles with noisy check valves in compressor discharge line, he has my sympathy, as I know what he has to go through, at least with the large type of compressor. My suggestions would be, first, try a check valve with a composition disc. Maybe it could be put on the present check. Or I would have a check valve installed of the feather-valve type which is noiseless, also discharge valves on the compressor of the same type. Then all noise would be eliminated. I have my troubles with large and small types, high and low speeds. Whenever metal to metal contacts are made with high pressures, there sure will be an awful noise when they come in contact with force. Possibly he could install a compression spring between cap and disc of check valve to do away with some of the noise.

Toledo, Ohio JOSEPH M. PAULY



IN 1941, the Wyman-Gordon Company, Ingalls-Shepard Division, Harvey, Ill., installed their first Flowmatic Regulator. Confronted with the problem of maintaining close boiler water level control in spite of severe load fluctuations produced by forging operations, they found Flowmatic to be the correct solution. As Mr. Max R. Boye, Chief Engineer of the Power Plant, has remarked on the return card of our routine check-up, the score is now 11 Boilers, 11 Copes Flowmatic Regulators.

Proved performance of this kind accounts for the remarkable record of more than 825 Copes Flowmatic installations since its introduction only 5 years ago.



The Copes Flowmatic Regulator offers a simple reliable means of maintaining exacting feed water control geared to the requirements of modern boiler design. It is especially valuable on installations subject to severe load fluctuations. For details, write for Bulletin 429-A.

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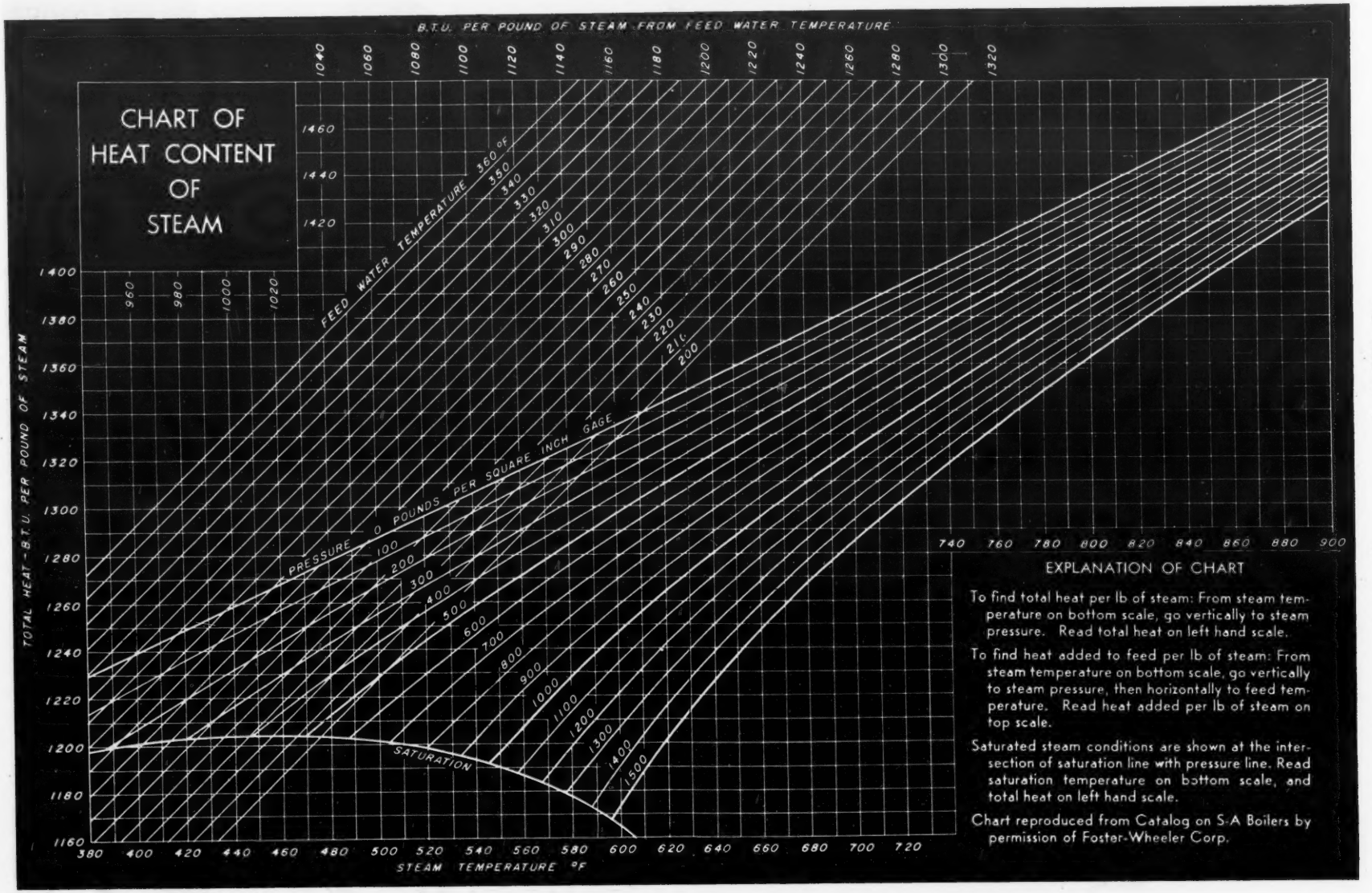
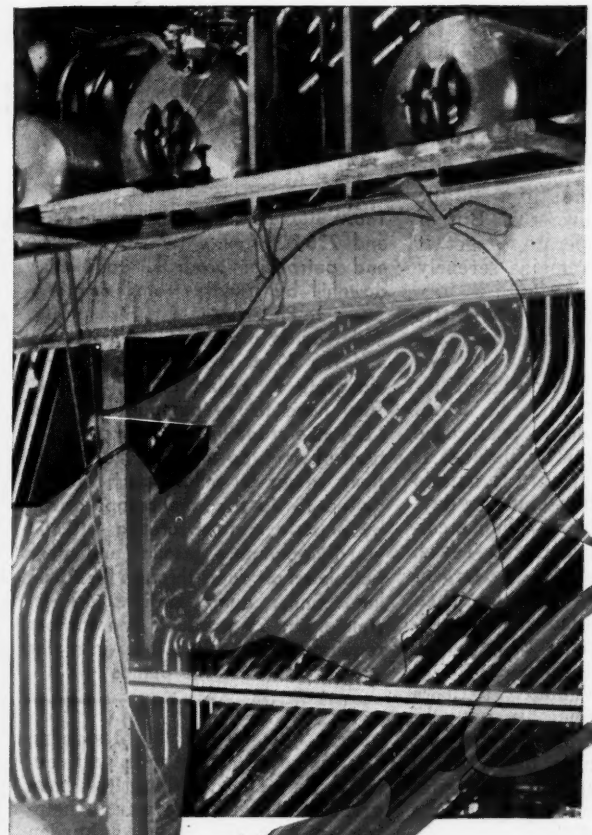


CHART OF HEAT CONTENT OF STEAM
B.T.U. PER POUND OF STEAM FROM FEED WATER TEMPERATURE
1040 1060 1080 1100 1120 1140 1160 1180 1200 1220 1240 1260 1280 1300 1320
1460
1440
1420
960
980
1000
1020
FEED WATER TEMPERATURE 360 °F 350 340 330 320 310 300 290 280 270 260 250 240 230 220 212 200
PRESSURE 0 POUNDS PER SQUARE INCH GAGE 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500
SATURATION
TOTAL HEAT - B.T.U. PER POUND OF STEAM
1400 1380 1360 1340 1320 1300 1280 1260 1240 1220 1200 1180 1160
380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700 720
STEAM TEMPERATURE °F
740 760 780 800 820 840 860 880 900
EXPLANATION OF CHART
To find total heat per lb of steam: From steam temperature on bottom scale, go vertically to steam pressure. Read total heat on left hand scale.
To find heat added to feed per lb of steam: From steam temperature on bottom scale, go vertically to steam pressure, then horizontally to feed temperature. Read heat added per lb of steam on top scale.
Saturated steam conditions are shown at the intersection of saturation line with pressure line. Read saturation temperature on bottom scale, and total heat on left hand scale.
Chart reproduced from Catalog on S-A Boilers by permission of Foster-Wheeler Corp.



A "BAFFLING" CASE... OF BOILER CORROSION

Serious corrosion in the steam drum of a boiler which had been in service only a year was being encountered by a Wisconsin central station. Betz engineers were called in to determine the cause of the trouble and to make recommendations for its elimination.

Internal inspection of this boiler revealed an unusual condition wherein the corrosion was confined to only a certain section of the steam drum, and the dry pipe and internal baffles in this section were literally flaking away. The products of this corrosion were identified through X-ray and chemical analysis as magnetic oxide of iron. Tests of the boiler water itself revealed that improper deaeration at the feedwater heater was allowing excessive quantities of dissolved oxygen to enter the boiler. However, the curious localization of the corrosive action was found to be due to unbalanced heat flow caused by incorrect furnace baffling coupled with improper flue damper adjustment. Recommendations were made for the proper operation of the deaerating heater, and through cooperation with the boiler manufacturer steps were taken to correct the unbalanced heat flow.

Although this case is somewhat unusual, it does illustrate how W. H. & L. D. BETZ renders a complete service on boiler water conditioning.

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ON ALL WATER PROBLEMS

W. H. & L. D. BETZ
FRANKFORD • PHILADELPHIA • PENNA.

Pumps—The Heart of Big Inch and Little Big Inch

Those 300,000 bbl a day of crude oil and 235,000 bbl a day of gasoline and petroleum products don't flow downhill by gravity from Longview, Texas, to Phoenixville, Pa., through the 24-in. crude pipeline called Big Inch and the 20-in. products line running alongside it, called Little Big Inch. They have to be pumped. On the 1254-mile crude line, 26 pumping stations of the type shown in the illustrations, about 50 miles apart, are required to do this, the pumps driven by electric motors totaling 118,800 hp. For pumping gasoline and other petroleum products through the 20-in. line, similar pump stations are installed, the 29 products line stations requiring about 100,500 hp in motor capacity to drive the pumps

SO MUCH has been published in newspapers and magazines about the construction of the Big Inch Pipeline by War Emergency Pipelines, Inc., that everybody is now familiar with it. But the real story of the laying of the pipe has never been told by the newspapers. It is known only to the engineers who did it and they may not have time to tell it for years. All the public knows is that oil and gasoline from Texas come out at Philadelphia and Linden, N. J., to drive their cars and to be shipped in ever increasing quantities to the Army and Navy overseas. But of the forces that operate to get it there, the public remains serenely unconscious.

The Big Inch and the Little Big Inch lines, one of the outstanding achievements of the present war, were carefully designed although quickly built. A 24-in. crude line was used in preference to other sizes primarily because it gave the correct capacity to handle a maximum of 300,000 bbl per day, which was available through a collecting pipeline system in Texas. This size pipe was also the largest seamless pipe that could be fabricated from steel billets as per specifications. Furthermore, a 24-in. line, as compared with lines of smaller diameter, was calculated to have 86 per cent pumping efficiency and capacities of 1200 bbl per day per ton of steel per mile, 67.4 bbl per day per hp per station, all higher than the corresponding quantities for smaller sizes of line.

Big Inch pumping costs, including taxes and depreciation average 13 ct per bbl, stated to be a lower cost than has ever been approached in pipeline pumping and promising a remarkable saving in transportation costs as compared with railroad and small diameter pipeline costs. The line cost $75,000,000 to $80,000,000 to build, about 10 per cent less than the estimated costs, remarkable savings in critical materials being made by designers, equipment manufacturers and constructors. It will doubtless have great value after the war in helping to ease the railroad burden while necessary rehabilitation is done and will also cushion tanker rates, which tend to fluctuate widely.

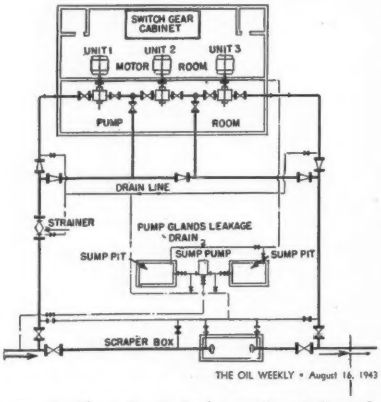

Fig. 1. Plan of a typical pumping station of the WEP 24-in. crude line, Big Inch, showing pump connections and main piping, through which any combination of pumps can pump 300,000 bbl a day of crude at 750 psi discharge pressure. Stations on 20-in. products line are similar but for pressures of 208-250 psi per pump. Drawing courtesy The Oil Weekly

Layout of Pumping Stations

The pipeline pumping stations are similar in design to those shown here, being laid out like Fig. 1 and standardized as much as possible for interchangeability. Manufacturers designed motors with the same base bolting and shaft heights,

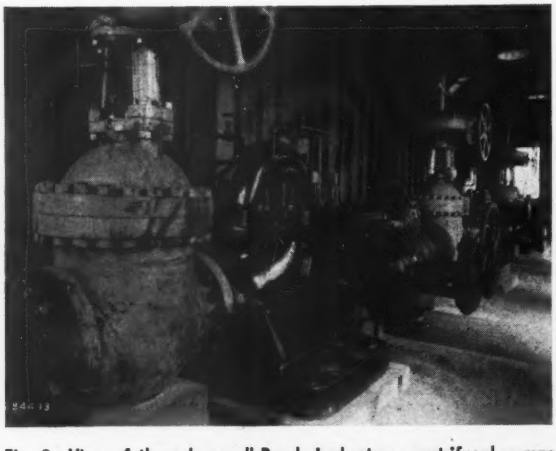

Fig. 2. View of three Ingersoll-Rand single-stage centrifugal pumps in series handling 8750 gpm of crude, in one of the stations. Driven at 1750 rpm by 1500-hp Westinghouse induction motors through the firewall. Photo courtesy The Oil Weekly

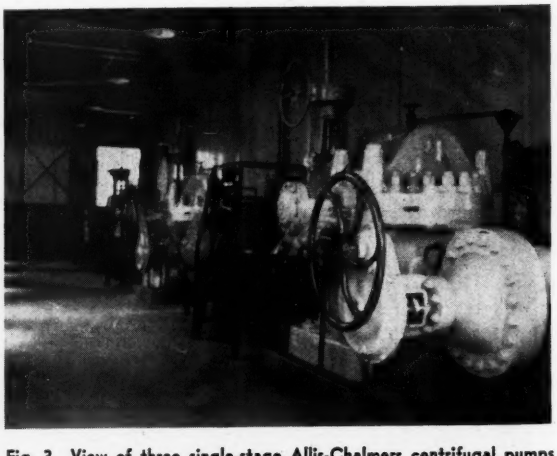

Fig. 3. View of three single-stage Allis-Chalmers centrifugal pumps in series in another station. They are driven by 1500-hp, 1750 rpm G-E induction motors. Standardized design permits these pumps to be interchanged with those of Fig. 2 if necessary

STREAMLINED

Tube-Turn welding fittings help to bring true streamlining to a piping system. They not only save space and weight, but permit neater layout and *more compact design*, with lines of piping nestling closely together, hugging walls and making the best use of corners or odd spaces. Insulation is far easier in piping systems where Tube-Turn welding fittings are used.

Tube-Turn seamless steel welding fittings themselves are basically streamlined. Their smooth inner surface, easy sweeping turns and full circularity reduce pressure loss and flow resistance at vital points where flow direction changes. No flow-impeding "offsets" where Tube-Turn fittings are used — no waves or ridges to accelerate corrosion or erosion! Write for Catalog 111.

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pumps with standardized flange bolting circles, spacing of suction and discharge openings and the like. Pumps had to be built of a maximum of non-critical materials.

The 24-in. crude line, the Big Inch, was built first; starting in August, 1942, the first 531-mile leg from Longview to Norris City, Ill., was completed four months later and the remaining 700 miles was completed and put in service in July, 1943. Construction on the parallel 20-in. products line was begun in April, 1943, and by December, 1943, the entire line was completed as far as Linden, N. J., its Eastern terminus. From Phoenixville, Pa., 20-in. lines carry the crude and products to Linden, N. J., and to Marcus Hook and Philadelphia.

As noted, pump stations on the 24-in. crude lines are about 52 miles apart, depending on the contour of the ground and on the hydraulic gradient. Each station delivers oil at 700-725 psi. It contains three 1750-rpm single-stage motor-driven centrifugal pumps, connected in series as shown in Figs. 1, 2 and 3. Each pump has a capacity of 8700 gpm. The piping connections, as shown, permit the three pumps to be operated in any desired combination of 1, 2, or 3 units to meet the requirements of through-put and pressure.

Pump Details of Crude Line Pumps

The feature of these pumps is probably their compactness, which will impress pipeliners accustomed to reciprocating pumps for such service. These pumps are the largest of their kind for this capacity and head. They were especially designed for this service by the manufacturers, working closely with the engineers of War Emergency Pipelines, Inc. Farther in this article are some details of the design features of the pumps for the products line, to illustrate the factors the manufacturers had to consider.

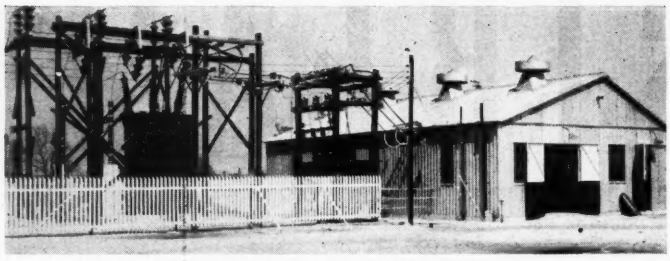

Fig. 4. Exterior view of a typical Big Inch pumping station, showing Westinghouse outdoor 3750-kva, 110-kv to 2300-v substation

A total of 78 of these pumps was provided for the 24-in. crude line. Each is driven, as shown in the illustrations, by a 1500-hp, 2300-v, 3-phase, 60 cycle induction motor, a firewall being placed between motors and pumps. In each motor room is installed the metal-clad switchgear for starting and controlling pipeline and auxiliary pumps. Reduced-voltage starting is used where required by the utility companies and all motors are protected against overload or high temperature, shutting down automatically if the ventilating system fails.

Automatic control of each pump station operation is by means of Mercoid switches actuated by pump suction and discharge pressure variations in such a way as to cut the respective pumps in or out of service as required to maintain pumping pressures desired. Stations are connected by private system telephone lines.

In the crude line stations, one of the features is the ventilating system for the main unit driving motors. A hood over each motor conducts heated air up to a horizontal duct overhead. Here operation of a chain-operated damper discharges the heated air directly through a head in the roof or through the horizontal duct, which is equipped with a flame arrestor, to the pump room, thus supplying heat to this room in winter.

The pumping equipment for the 20-in. products line, running from Beaumont, Tex., to Little Rock, Ark., and thence paralleling the 24-in. crude line to New Jersey, is similar in many respects. As before, the products line pumping stations, 29 in number, are about 52 miles apart. They are designed for a through-put of 235,000 bbl per day. These are separate stations from those on the crude line.

The layout of each product station is approximately the same as shown in Fig. 1. Each contains three 6850-gpm, single-stage motor-driven centrifugal pumps, designed to discharge against 750-825 ft head or 208-275 psi per pump. They are of the same general design as the crude pumps except that they operate at 3600 rpm and are driven by 1250-hp, 2300-v, 3-phase 60-cycle induction motors.

The products line is operated as a loaded line and under pressure. A principal feature of the products line station is the more extensive automatic control required, as described below.

Control of the products line pumps is as follows: It is initiated from a single flow control valve in the suction line to the station. This is actuated from a Mercoid switch

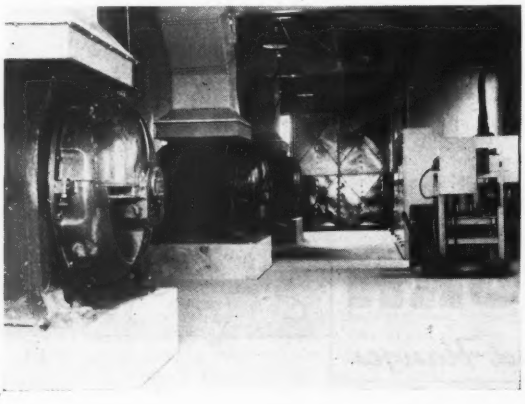

Fig. 5—Left. View in motor room of typical Big Inch pumping station showing three General Electric 1500-hp, 1750-rpm, 2300-v induction motors driving main pumps. Ventilating ducts discharge to atmosphere or to pump room in winter. G-E metal clad switchgear and motor control equipment at right

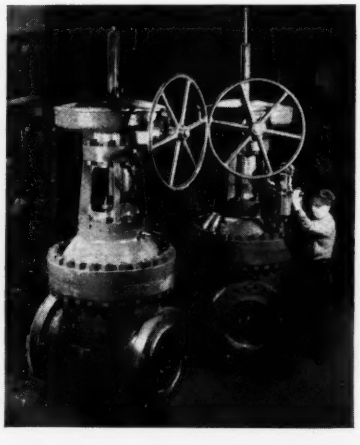

Fig. 6—Right. Two of the 20-in. hand-operated gate valves built especially for the products line stations by Allis-Chalmers Mfg. Co.

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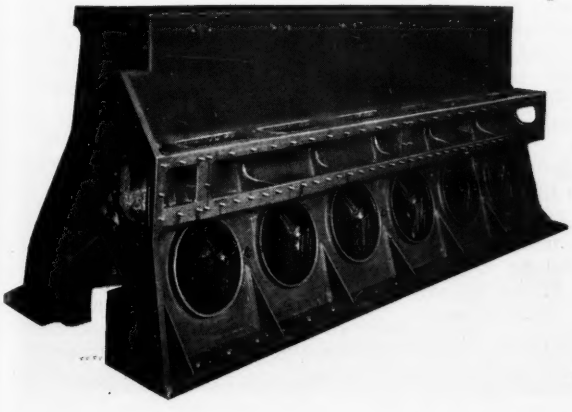

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in the suction line; after the suction valve is open, the control starts the driving motor and then opens the pump discharge valve. This controls starting and normal operation; the station is shut down manually. The control panel and a diagrammatic panel of the station connections are in a separate room.

Each products line pump is protected by safety devices that shut down the unit and give a light signal and sound alarm if the pump or motor bearing temperatures, pump casing or motor winding temperatures go above safe values. All electrical controls are through standard relays wherever possible, as an attempt was made to avoid use of time delay relays.

All electric power for operating these pumping stations is purchased from the local public utilities in the regions through which the pipeline runs, some of the utilities extending and amplifying their transmission facilities for this purpose. At each station, a step-down substation, as in Fig. 4, is installed as part of the pumping station equipment.

Products Line Pumps

Figure 7 shows a detailed cross-section through one of the products line pumps and Fig. 8 gives curves of performance under test. The general procedure followed by each manufacturer in designing these pumps was much the same as he followed in designing the crude pumps he supplied. However, a number of new and difficult problems now entered the products line problem, if highest efficiency and reliability were to be obtained and still meet the rigid delivery schedule.

The engineers of the manufacturers and the WEP decided to use three double-suction single-stage pumps per station just as in the crude line stations. These would give higher efficiency, better price and shipment, since no multi-stage pumps were developed that would do the job. Hence each pump was designed to handle 6850 gpm at heads ranging from 875 ft max or 275 psi down to 667 ft or 208 psi on a specific gravity of 0.72, as in Fig. 8.

Design of Products Line Pumps

A normal design for a pump of this capacity would call for a speed of not over 1775 rpm with a specific speed at maximum head of 920, too low for good efficiency. At 3670 rpm, however, the specific speed would be 1845, and it was felt this would give at least 3 per cent better efficiency and a saving of $150,000 a year which would soon pay for the higher cost of two-pole motors. There was not much precedent for a pump of this capacity and head at 3670 rpm but calculation showed it feasible if about 80 ft of suction head were assured to prevent cavitation.

All pumps were standardized with 14-in. suction and 12-in. discharge and interchangeable as to base plate, wall stuffing boxes and flange nozzle locations, so that all stations would be alike and pumps of one manufacturer could replace those of another. The 1250-hp, 3670 rpm cage motors were all made interchangeable in mounting dimensions.

Design of details was left to each manufacturer. For the pump shown in Fig. 7 the double volute casing design was used to give radial balance at all capacities. Two heavy vertical ribs were used in each casing, running entirely around it and tying into the feet, to prevent excessive deformation of the casing. This is of high-test cast iron or semi-steel of 45,000 psi tensile strength. Bolt material was NE 9442 heat treated to 100,000 psi tensile strength; fifteen 1¾ in. bolts and four 2½ in. bolts were required, all prestressed to 30,000 psi. Heat treated cap nuts and hardened and polished ground washers were used. The joint was made with 1/64-in. thick compressed asbestos gasket, relieved around the bolt.

The impeller has an eye speed of 125 fps, peripheral speed 235 fps. It has seven vanes so that no two vanes will be opposite a cut-off point at once. It is made of bronze and dynamically balanced.

Impeller wearing rings are 13 per cent chrome steel hardened to 360 Brinnell and casing wearing rings of bronze, serrated to reduce leakage. These two metals run well together. The shaft diameter was selected on the basis of careful graphical analysis, so it would not operate near critical speed. It is of SAE 2330 forged steel.

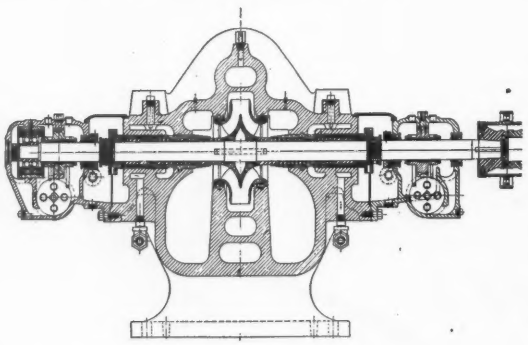
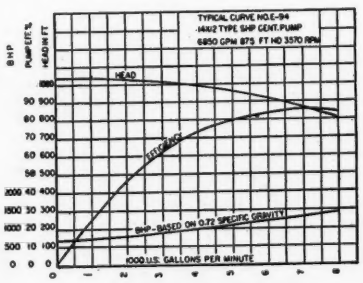


Fig. 7—Left. Cross-section through one of the Allis-Chalmers 6850-gpm, 3600-rpm, 14-in. by 12-in. 275-psi head, centrifugal pumps installed in products line stations, three in series like Fig. 1

Fig. 8—Right. Performance test curves of pump shown in Fig. 7



Stuffing Boxes, Packing, Bearings

Stuffing box design was important, for surge conditions in shutting down in emergencies might cause very high suction pressures, also the mile-a-minute speed of the shaft through the packing generates heat that must be dissipated.

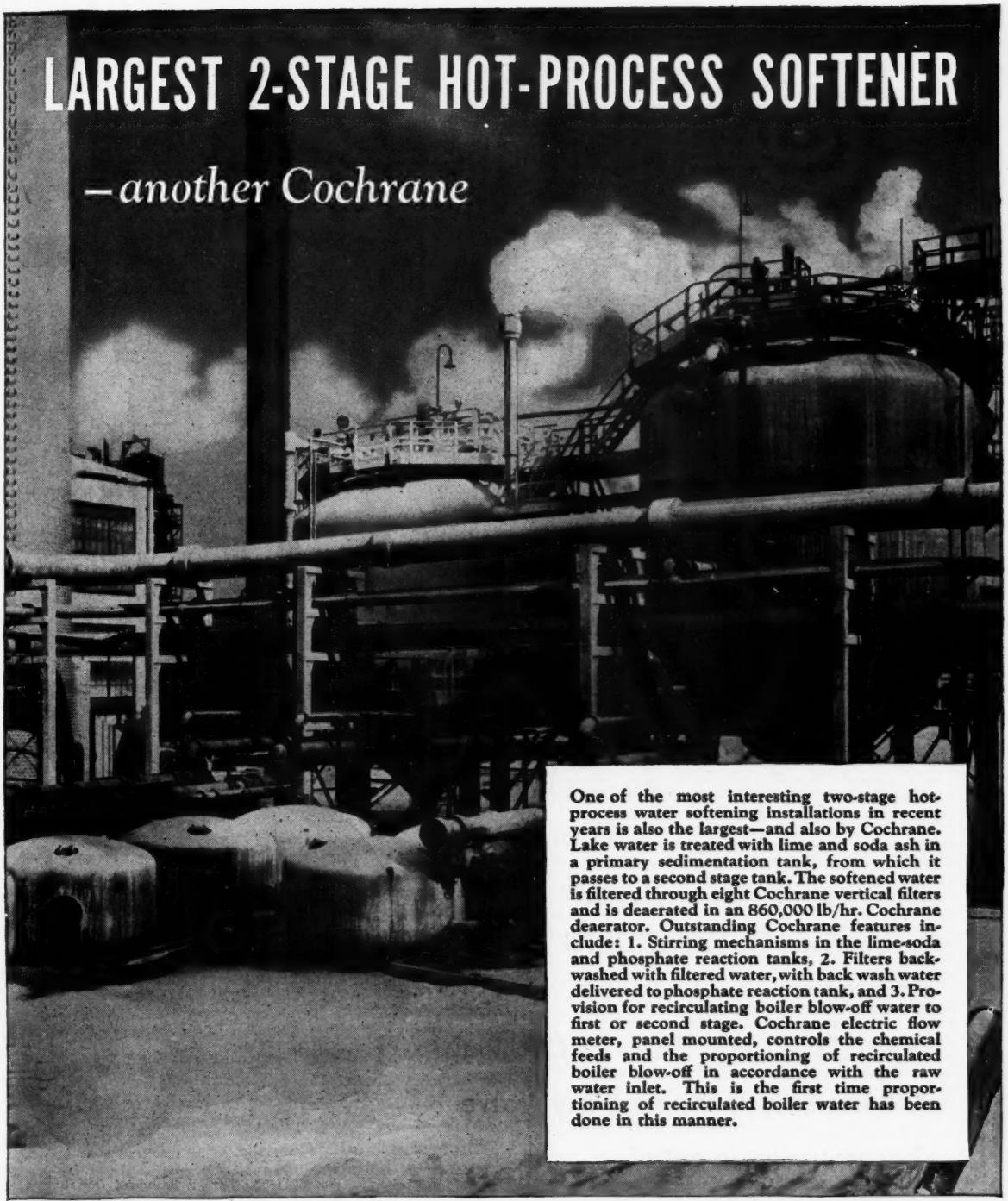
The final design represents the experience of the WEP, packing company and pump manufacturer's engineers. Long serrated bushings were provided at the base of the stuffing box on No. 2 and No. 3 pumps and the leakage from No. 1 pump is led into the sump. This arrangement is also used on the 24-in. crude line pumps. Relief valves on the leak-off lines will open if there is a surge in the suction line and discharge the leakage direct to the sump.

Hard metallic packing, designed to run without lubricant, was used but provision is made for later installation of lubricators if necessary. To cool the packing, leakage from the stuffing box bushing is brought through a cored passage around the packing. Shaft sleeves are 13 per cent chrome steel, all other stuffing box parts non-spark-

(*Continued on Page* 148)

LARGEST 2-STAGE HOT-PROCESS SOFTENER

—another Cochrane



One of the most interesting two-stage hot-process water softening installations in recent years is also the largest—and also by Cochrane. Lake water is treated with lime and soda ash in a primary sedimentation tank, from which it passes to a second stage tank. The softened water is filtered through eight Cochrane vertical filters and is deaerated in an 860,000 lb/hr. Cochrane deaerator. Outstanding Cochrane features include: 1. Stirring mechanisms in the lime-soda and phosphate reaction tanks, 2. Filters backwashed with filtered water, with back wash water delivered to phosphate reaction tank, and 3. Provision for recirculating boiler blow-off water to first or second stage. Cochrane electric flow meter, panel mounted, controls the chemical feeds and the proportioning of recirculated boiler blow-off in accordance with the raw water inlet. This is the first time proportioning of recirculated boiler water has been done in this manner.

COCHRANE CORPORATION **3123 N. 17th Street, PHILADELPHIA 32, PA.**

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OUTSTANDING VALVE SERVICE

Discs that seat tight, operating mechanisms that open and close the valve easily, stuffing boxes that are amply deep and conveniently repacked, bodies with an ample margin of strength, precision machine work throughout . . . all these factors that provide OUTSTANDING VALVE SERVICE are found in every KENNEDY Valve. Write for Catalog 63 describing these Kennedy Valve characteristics in detail.

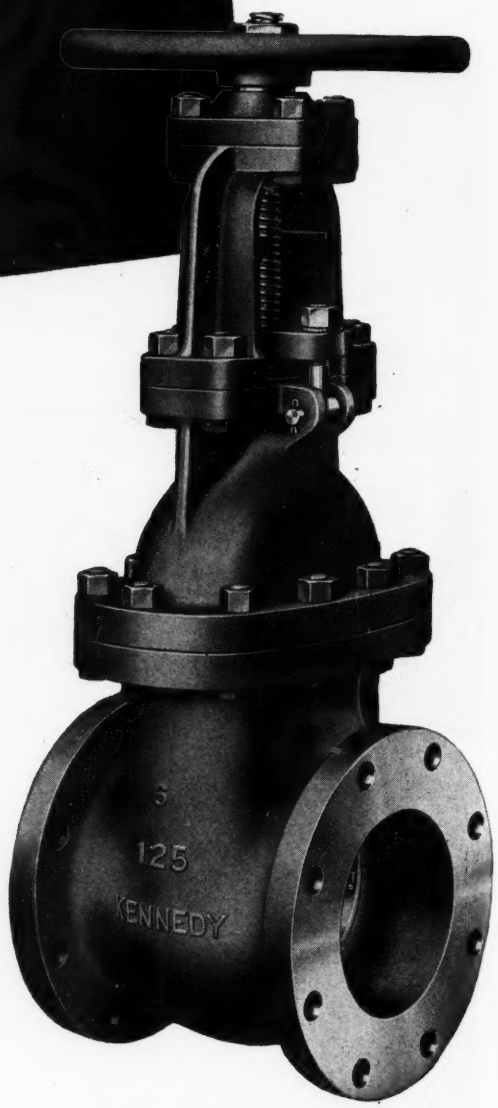

Fig. 0611—KENNEDY Standard Iron Body Wedge Gate Valve with outside Screw and Yoke

Kennedy Iron Body Wedge Gate and Double Disc Gate Valves are also built for pressures up to 250-lb. steam and 500-lb. water.

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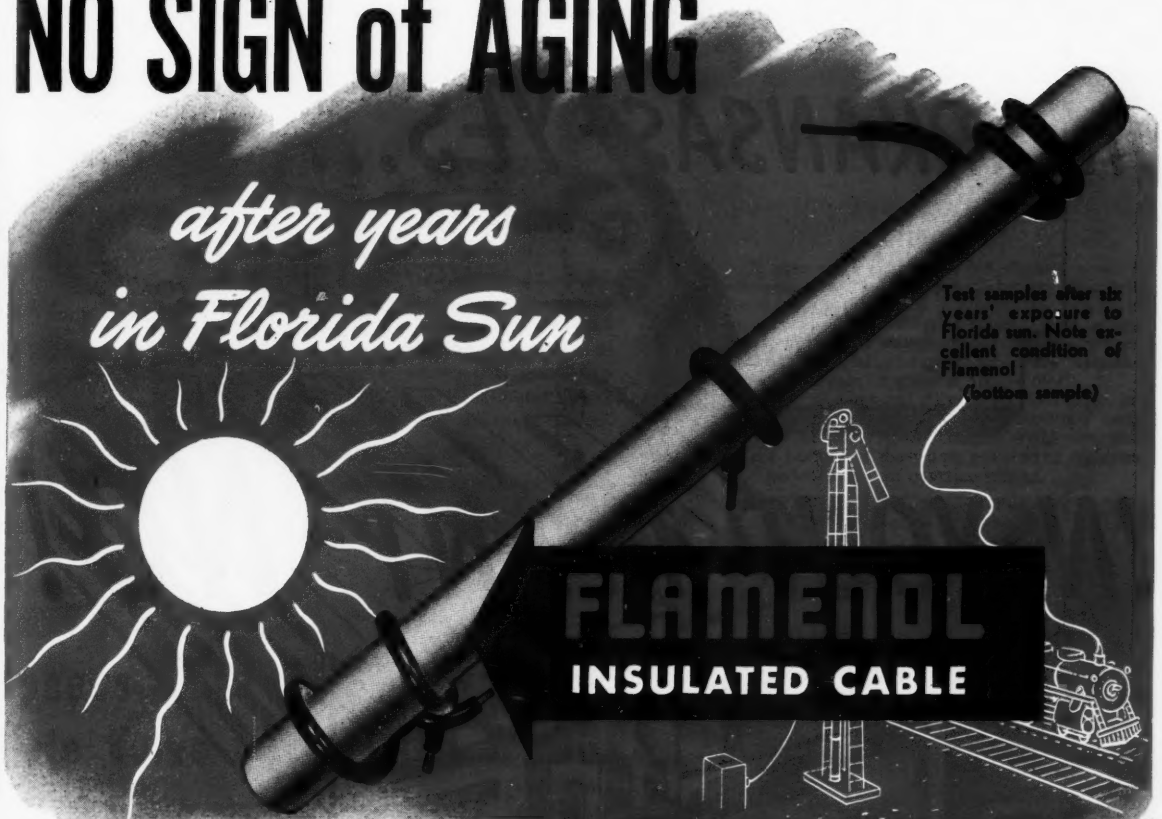
THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.

NO SIGN of AGING

after years in Florida Sun


Test samples after six years' exposure to Florida sun. Note excellent condition of Flamenol (bottom sample)
FLAMENOL
INSULATED CABLE

Long exposure to weather proves value of G-E synthetic cable for outdoor applications

In 1937, a large railroad operating in the South decided to compare the aging qualities of various cable insulations. Line drops of three types of cable—one had an oil-base rubber insulation, one had a mineral-base rubber, and one was Flamenol*—were installed.

None of the cables was braid covered—in each case the insulation was exposed to sun and weather.

After six years' operation, the samples were removed for inspection. As shown in the photograph above, the insulation on two of the samples had aged considerably, but the Flamenol was still in excellent condition.

Flamenol—the pre-Pearl Harbor synthetic-insulated cable

When war broke out in Europe, millions of feet of Flamenol cable already had been installed in automotive, chemical, food, textile, and other plants, as well as in mines and oil refineries, and on railroads.

For wiring installations subjected to acid, alkaline, oily or moist conditions, fire hazard, or weather, Flamenol is the *proved-performance* cable. Note, at right, its operating, installation, and maintenance advantages. For complete information, ask our local office, or write to *General Electric Co., Schenectady 5, N. Y.*

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1. **FLAME RESISTANCE**—does not support combustion.
2. **CORROSION RESISTANCE**—immune to action of oils, acids, alkalies.
3. **SUPER-AGING**—does not oxidize. Highly resistant to sunlight and weathering.
4. **EXCELLENT PHYSICAL PROPERTIES**—has minimum tensile strength of 1500 lb per sq in., minimum elongation of 100 per cent.
5. **DIELECTRIC STRENGTH**—retained at about 720 volts per mil through severe operating conditions.
6. **SMALL DIAMETER**—saves space, facilitates wiring.
7. **SMOOTH SURFACE**—facilitates pulling through conduit.
8. **FREE STRIPPING**—speeds splicing, avoids nicking conductors.
9. **DIFFERENT COLORS**—simplify circuit tracing.
10. **VARIOUS CONSTRUCTIONS**—aid selection for special applications.
11. **SELF-PROTECTING FINISH**—eliminates need for braid, less space required.

*Reg. U.S. Pat. Off.

BUY WAR BONDS

GENERAL ELECTRIC

IN ARKANSAS YES...

IN YOUR PLANT—NO!

"MY CABIN never leaks when it does not rain..." goes the ballad about the native who was not concerned about his roof in fair weather.

Do you regard condenser maintenance in the same light... do nothing till leaks occur and so many tubes are plugged that the unit is ineffective? Ever had to shut down to repair condensers?

Why not have a Conseco overhaul to minimize condenser troubles — while your system is down for general checkup? Condenser Service has men, knowledge and facilities to re-condition your condensers quickly and assure you of uninterrupted service.

Hydro-dynamic shock test knocks-out tubes, not yet leaking, that would probably fail during the next service period. Replacing these weak members along with tubes that have already failed means you have a condenser back in service "good as new".

Conseco service is 24-hour service... with crews all over the country, one is always near you. Play safe, and call us when your condensers need doctoring.

Condenser Service
AND ENGINEERING CO., INC.

83 RIVER STREET, HOBOKEN, NEW JERSEY

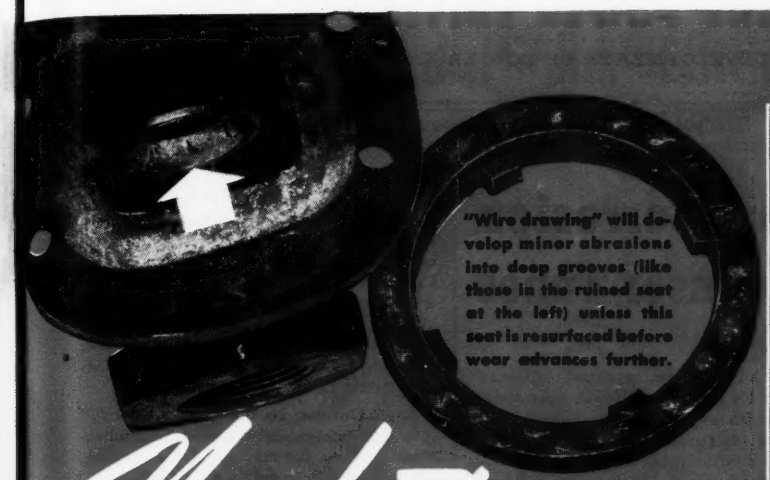
★

NEW JERSEY TELEPHONE—HOBOKEN 3-4425

NEW YORK TELEPHONE—RECTOR 2-9360 **AFTER 6 P. M. AND SUNDAYS—HOBOKEN 3-4428**

6-C5-3

Prevent Valve Failure *before it starts!*



"Wire drawing" will develop minor abrasions into deep grooves (like those in the ruined seat at the left) unless this seat is resurfaced before wear advances further.

Neglect speeds SELF-DESTRUCTION of Gate Valve SEATS and WEDGES

Timely Maintenance Eliminates Danger Spots . . .

Excessive wedge and seat damage in gate valves can be arrested, and service life considerably lengthened, by periodic inspections and regular maintenance *in time.*

This "ounce of prevention" is even more essential for gate valves than for other styles. Seat ring replacement in gate valves is exceptionally difficult. Few repair shops are equipped with the tools and gauges needed to insure proper installation and an absolutely tight valve. It is advisable to return valves 6" and over to the manufacturer for refacing or replacement.

Temporary control of leakage in gate valves can sometimes be accomplished by reversing the wedge. If the valve is not of the reversible wedge type, the valve itself can be reversed until permanent repairs can be made.

The surest way to keep valves operating efficiently – to prevent slow downs in delivery of vital war goods – is to stop valve trouble *before* it starts. Inspect valves frequently . . . repair or replace worn parts in time to prevent valves from destroying themselves . . . select and install valves carefully . . . train maintenance men thoroughly.

Jenkins Engineers will assist any management in preparing an effective program of valve conservation.

Jenkins Bros., 80 White Street, New York 13, N. Y.; Bridgeport, Conn.; Atlanta, Ga.; Boston, Mass.; Philadelphia, Pa.; Chicago, Ill. Jenkins Bros., Ltd., Montreal; London, England.

JENKINS VALVES

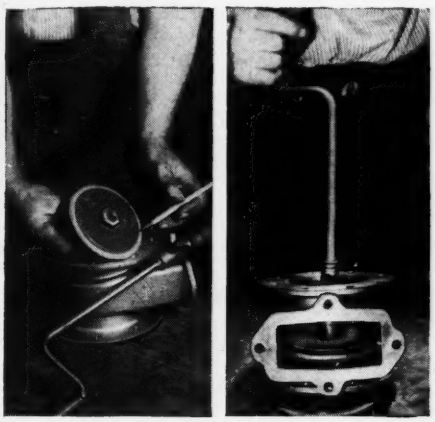
SINCE 1864

For every industrial, engineering, marine and plumbing-heating service . . . in Bronze, Iron, Cast Steel and Corrosion-Resisting Alloys . . . 125 to 600 lbs. pressure.

GRINDING BY HAND RESURFACES SEATS WITH MINOR WEAR

If gate valve seats are only slightly worn or affected, they can be restored by grinding with hand tools as illustrated. A metal plate, fitted with an emery cloth washer, is rotated with a hand brace, in which a universal joint prevents uneven cutting. Special reseating tools are necessary when deep cuts or grooves are present.

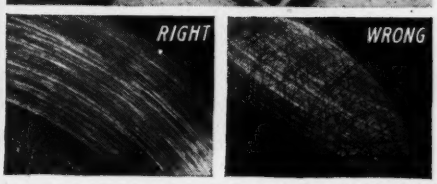
When refacing seat rings, treat both alike, and remove no more metal than is absolutely necessary. If too much is taken off, the wedge may drop to the bottom of the valve, preventing tightness, and necessitating an oversize wedge.



SIMPLE JIG ASSURES CONCENTRIC RESURFACING OF WEDGES

Wedges must be ground carefully to preserve the correct taper and avoid radial scratches that will invite further damage. By making and using the simple bench fixture shown, with a V block to guide the wedge when it is oscillated about a third of a turn or so, the concentric facing (RIGHT) will be left by the grinding operation. Scratched surfaces of an irregular design (WRONG), which hasten leaks, result from grinding without a guide.

A wedge may be resurfaced simply by holding it against a revolving emery disc affixed to the face plate of a lathe. The wedge should be kept central, and the pressure uniform, to avoid uneven grinding. Wedges worn too badly to be resurfaced by grinding can be turned in a lathe with the use of a face plate of correct taper.



COPPER ALLOY BULLETIN

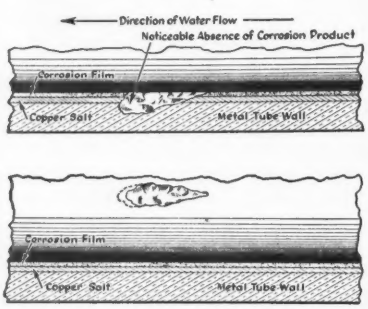
MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Fighting Impingement Corrosion with Duronze IV Condenser Tubes

When an impinging stream of water containing air and other entrained gases attacks and wears through the protective film of a plain brass condenser tube it gains access to the underlying layer of corrosion salts. When this occurs the corrosion products are soon swept aside and the bare metal is exposed. The impinging stream then continues to aid in the removal of the metal itself producing typical almond or crescent-shaped pits under cut on one side as illustrated below.



To overcome impingement pitting, Bridgeport Brass Company is producing a number of condenser tube alloys which are more resistant to this type of attack that rapidly perforates brass tubing. Outstanding in this respect is Duronze IV, an alloy which fortunately is now available for both land and marine power plants.

Although the merits of the Duronze IV type of alloy has been known for many years, only experimental quantities were produced because of the difficulties involved in its manufacture.

However, through special casting technique and the use of more powerful mill equipment, Bridgeport has solved this problem with the result that Duronze IV is now classed as one of our standard condenser tube alloys.

Proof of the superiority of the Duronze IV type of alloy to other condenser tube alloys for brackish water corrosion is well illustrated by the remarkable service record of an experimental installation of about 5000 tubes which were put into a seaboard condenser in 1913. These tubes had outlived their usefulness in 1942—*a period of 29 years*—in which time only minor replacements were made! In the same power plant, two adjacent condensers of identical design have been using Admiralty condenser tubes whose life averaged six years.

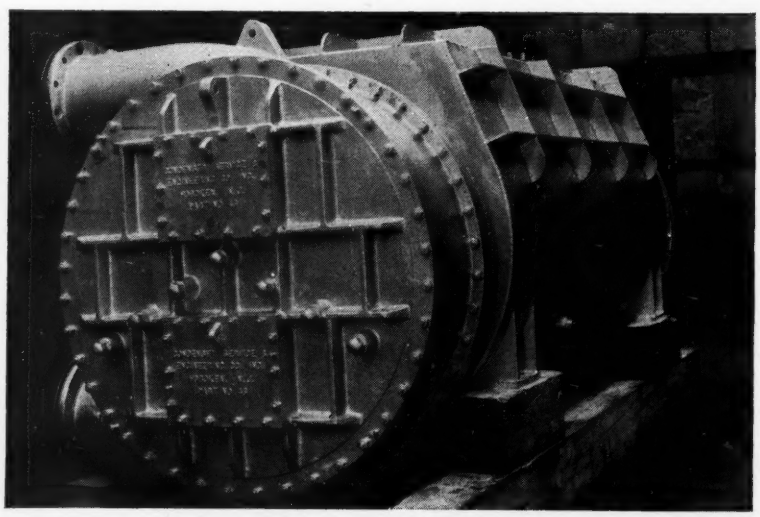
In another seaboard power plant where Admiralty lasts from 2½ to 3 years, and Aluminum Brass 4 to 5 years, Duronze IV has now been in about 5 years and is giving fine service.

An experimental lot of Duronze IV, Cupro Nickel, Aluminum Brass and Admiralty condenser tubes were installed in another seaboard power station which is troubled by brackish water resulting in excessive deposit attack. Here Admiralty and Aluminum Brass failed after 6 months, Cupro Nickel failed in about 1½ years while Duronze IV is still in fine condition after 3 years of service. Besides being excellent for general corrosion conditions, Duronze IV withstands impingement attack better than most other alloys.

Since Duronze IV does not "dezincify" it is also widely used in industrial applications such as for conveying hot, strong, brine solutions in salt refineries.

Engineers who are planning to retube their condensers would do well to consider using Duronze IV especially if operating conditions are too severe for ordinary condenser tubes. However, if they are not ready to do a retubing job, they should put in an experimental lot for periodic observation. Those who have not yet tried out Duronze IV have a pleasant surprise in store for themselves.

Much data on Duronze IV and other Bridgeport alloys and results of many years of corrosion research are published in Bridgeport's 80-page Condenser Tube Manual. Be sure to write for a copy using company stationery.



4,000 sq. ft. condenser manufactured by the Condenser Service and Engineering Company.

Note: Bridgeport products are supplied in accordance with existing priority regulations.

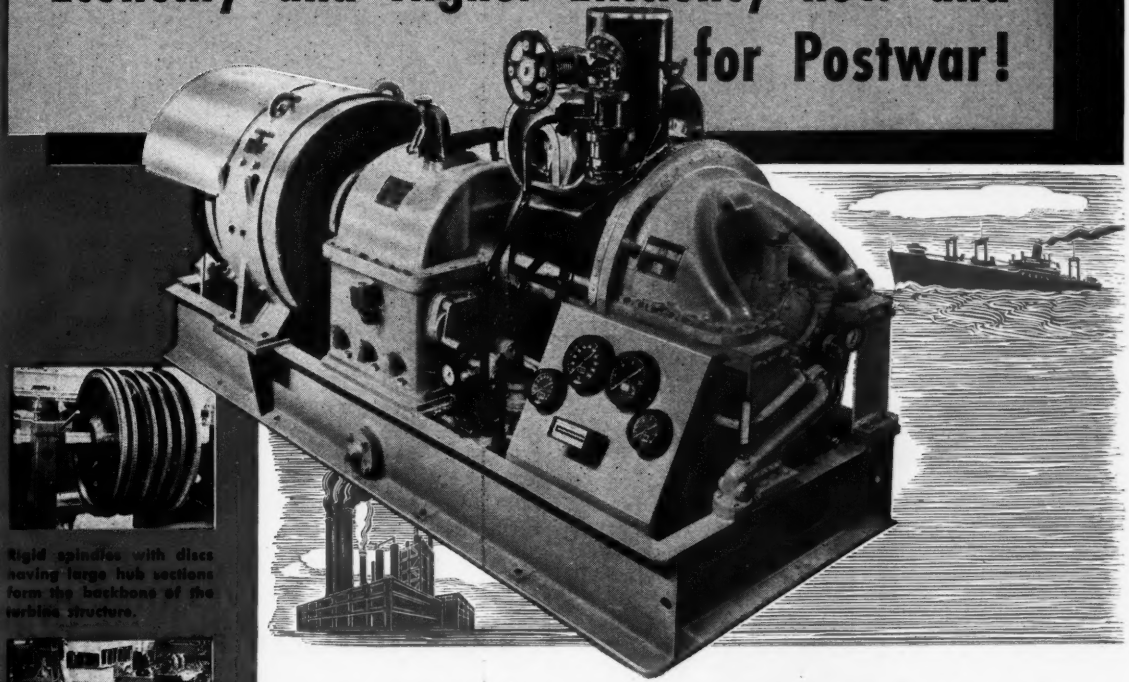
BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ARMY E NAVY

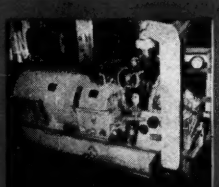
ESTABLISHED 1865

HENDY'S NEW TURBO-GENERATOR Assures Economy and Higher Efficiency now and for Postwar!



Rigid spindles with discs having large hub sections form the backbone of the turbine structure.

Production-line assembly of Hendy turbines is possible, through the application of exacting dimensional-control systems.



A portion of the extensive testing stands where exhaustive tests are given each Hendy Turbo-generating plant before it is marked "OK for shipment."

This smooth, compact Hendy Turbo-generator plant is built to the rigorous requirements of war service. Proving its economy of operation and higher efficiency under today's exacting demands, it will be ready to serve in many marine and industrial uses of the postwar era.

Among the features that distinguish this new Hendy power plant are:

1. Fabricated steel reduction gear case encloses the oil pump, priming pump, governor and its power unit, and the high-speed pinion coupling.
2. New-type, simplified governing mechanism requiring no stuffing boxes or soft packing, insures closer speed regulation and uniform output.
3. Parts subject to normal wear or periodic inspection are designed for maximum accessibility to reduce time required for servicing.
4. Location of filters, strainers, coolers and controls eliminates much piping and increases over-all efficiency.

Hendy Turbo-generators can be built to your exacting requirements in a range of 250 to 750 kw. Larger ratings are being designed. Your inquiries are invited.

JOSHUA HENDY Division

JOSHUA HENDY IRON WORKS

SUNNYVALE, CALIFORNIA

EST. 1854

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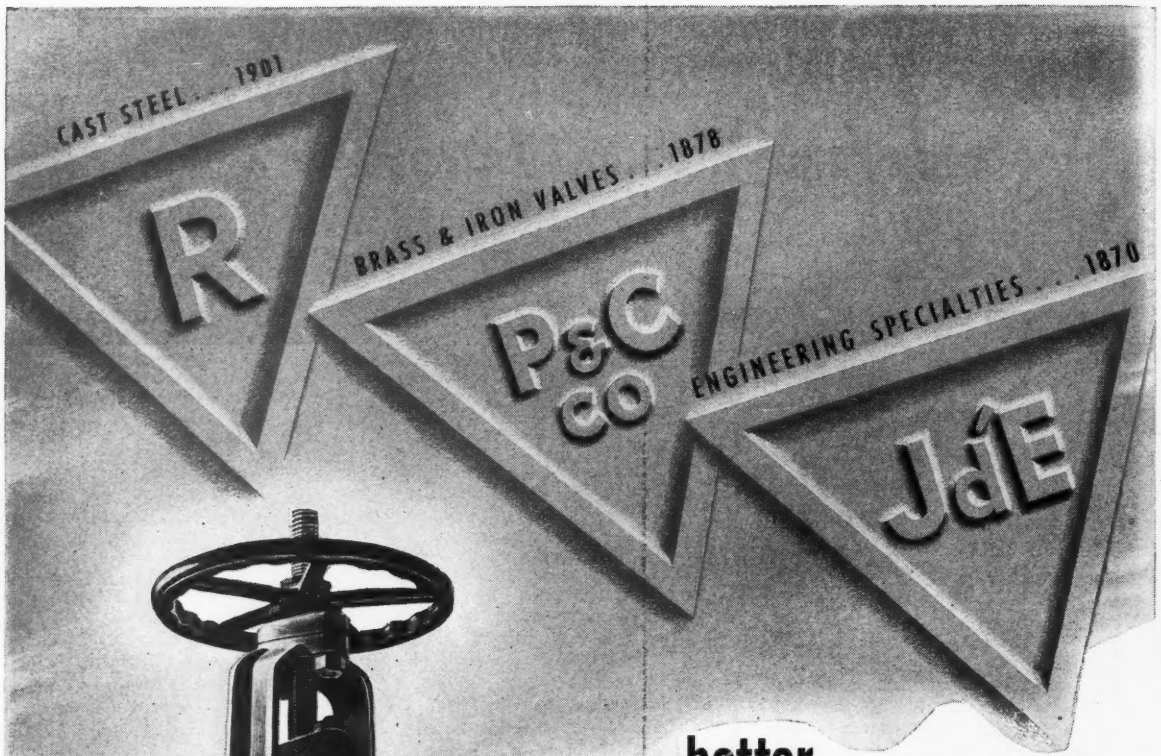
TURBO-GENERATORS

REDUCTION GEARS

STEAM TURBINES

DIESEL ENGINES



YOU GET **better** VALVES THROUGH R. P. & C. SPECIALIZED PRODUCTION

"READING" Cast Steel Valves and Fittings are made by an organization that has devoted its whole life to developing pressure steel castings—castings finished into valves and fittings in accord with designs for high temperature service.

"PRATT & CADY" patents for brass and iron valves, now expired, show its participation in early developments of the valve industry—particularly the development of renewable features.

"D'ESTE" was an original manufacturer of reducing valves and pressure regulators—introducing the piston internal pilot control type.

★ ★ ★

Thus, READING-PRATT & CADY *offers you a single source for your valves. Whether they be of cast steel, brass or cast iron, or whether they be manually operated gates, globes, checks, et cetera, or automatically controlled regulators—they are made by an organization experienced, tooled and manned for the production of its particular type of valve, but each able to give you every advantage of the best thinking of the others. You get better valves through* R. P. & C. *specialized production.*

READING-PRATT & CADY

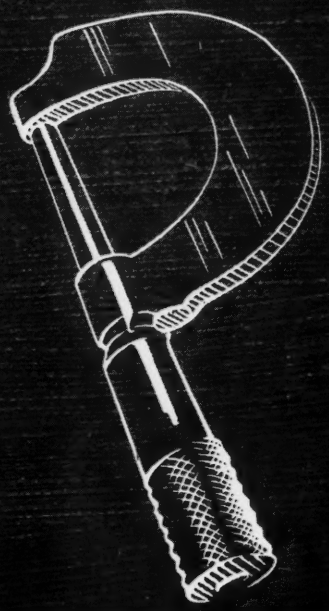
MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

Reading, Pa., Atlanta, Boston, Chicago, Denver, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco

ACCO

A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc. BRIDGEPORT, CONNECTICUT

How a film .0025″ thick *adds years of life* TO BOILERS



APEXIOR...a technical protective coating for mechanical equipment

An impenetrable barrier against water, which will add years of life to new boilers and provide added service from old boilers . . . is available to you in APEXIOR NUMBER 1. Two coats of this high temperature water and steam resistant paint, measuring .0025″ in thickness, will resist wear and corrosion over a long period of time. And it is renewable by applying a single coat when needed, possibly once in two to three years.

Under average conditions, and when boiler deposits, if any, can be washed down or removed by means of a light bristle or wire brush, the coating may last for several years. A single make-up maintenance coat is generally necessary after mechanical cleaning with a sharp cutting head.

APEXIOR is brush-applied by hand or power-coater. It is easily renewed.

Painting boiler metal with APEXIOR is recommended by boiler insurance companies. And many manufacturers of turbines coat shafts, rotor bodies, and frequently interiors of casings with APEXIOR before shipping to customers.

Hundreds of operators have used APEXIOR NUMBER 1 for years as an economical means of boiler maintenance. Recently, many more have adopted APEXIOR as a guarantee of longer life for metal that cannot be replaced. They discovered that boilers nearing the end of their life, if able to pass inspection and a hydrostatic test, could be APEXIORIZED for years of extra service.

HOW TO GET PEAK PRODUCTION WITH PEAK PROTECTION

Write today for bulletin 1290 (*Industrial*) or 1305 (*Marine*) describing APEXIOR in detail.

APEXIOR is used by such representative organizations as these:

The Detroit Edison Co.
Gulf Shipbuilding Corp.
Curtiss-Wright Corp.
Louisville Gas & Electric Co.
American Smelting & Refining Co.
National Biscuit Co.
Union Carbide & Carbon Corp.
Socony Vacuum Oil Co.
Carnation Co.
Illinois Central R. R. System

APEXIOR

A Peacetime Plus ★ ★ ★ A Wartime Must

RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES

The **DAMPNEY COMPANY of America**

protective coatings for

STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Mass.

Please send free Bulletin 1290 (Industrial) ☐ 1305 (Marine) ☐

Name .....

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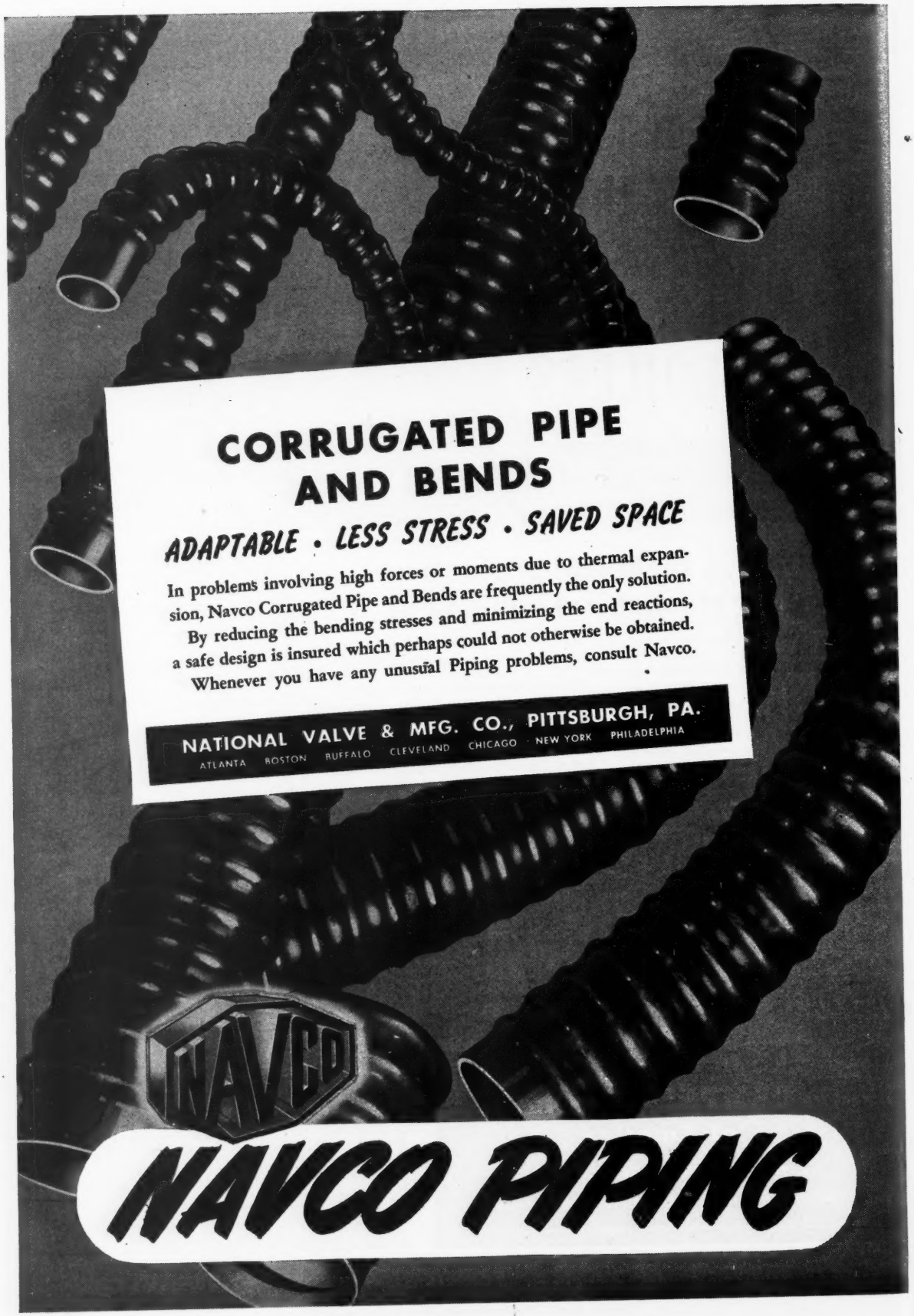
Main Office: **HYDE PARK • BOSTON 36, MASS.** • *Branch Offices:* **ATLANTA • CHICAGO • NEW YORK • DETROIT • PHILADELPHIA**

Engineering Sales Representatives — Pittsburgh, Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B. C., Montreal, P. Q., Havana, Cuba, Honolulu, T. H., Marine Dept., 114 Liberty Street, New York City, N. Y.


CORRUGATED PIPE
AND BENDS
ADAPTABLE • LESS STRESS • SAVED SPACE
In problems involving high forces or moments due to thermal expansion, Navco Corrugated Pipe and Bends are frequently the only solution.
By reducing the bending stresses and minimizing the end reactions, a safe design is insured which perhaps could not otherwise be obtained.
Whenever you have any unusual Piping problems, consult Navco.
NATIONAL VALVE & MFG. CO., PITTSBURGH, PA.
ATLANTA BOSTON BUFFALO CLEVELAND CHICAGO NEW YORK PHILADELPHIA
NAVCO
NAVCO PIPING

This is the way to seal flanged joints

FLEXITALLIC "C-G" GASKET

...the safe, sure sealing member for Raised-Face, Smooth Face, Van Stone or Cranelap fittings

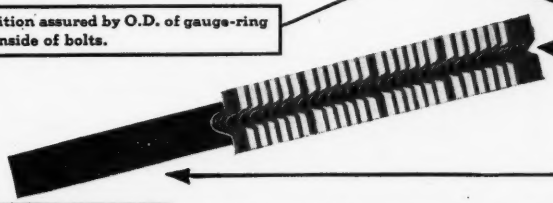
Seal is made and kept by spiral-wound, stainless-steel gasket which automatically expands and contracts with variations in temperature and pressure.

I.D. of gasket is clear of orifice at all points, offering no impediment in line.

Correct bonding load assured by surrounding solid-metal ring which serves as a thickness gauge for gasket when joint is made up.

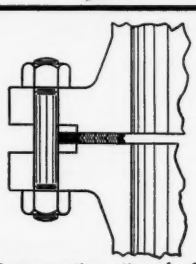
Fit of surrounding ring, allows inner member to expand under compression.

Correct position assured by O.D. of gauge-ring which fits inside of bolts.



Construction of each spiral-wound member is governed by design of fittings and by the required bonding load for working pressure and temperature.

Gauge-ring saves installation time. Gasket is correctly installed when flanges are brought down to the ring in making up joint.



Diagrammatic section of a C-G Gasket with typical Raised Face fittings showing the flanges compressed to the thickness of the solid metal member.

In the period coming up to the war, Flexitallic engineers developed the C-G Gasket—a fortunate development in that the gasket was ready for war use. Production of C-G's has gone for war purposes, chiefly on ships, where the gaskets have saved many thousands of dollars in ship-construction time and have performed in a way which we want someday to report to you in detail.

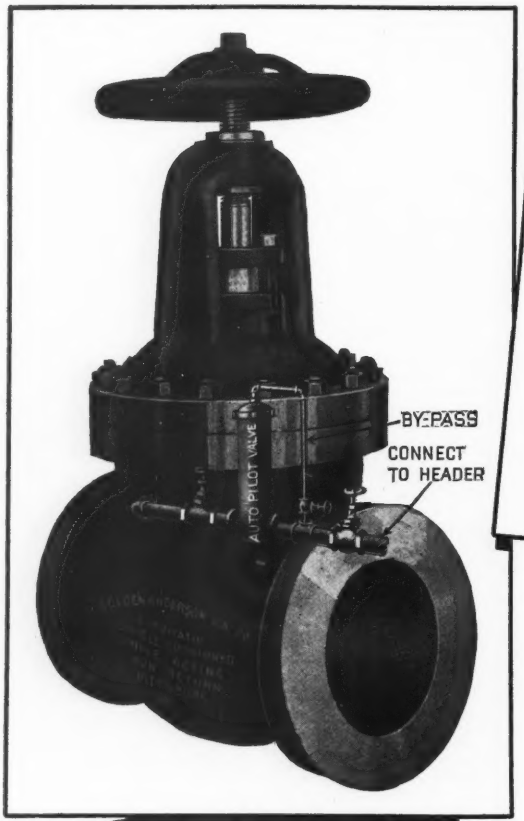
Meantime, note the construction features of the C-G. A day will come when we will be able to deliver these gaskets plentifully for installation ashore as well as aboard ship—and you will want to have these C-G features helping you. We will be glad to send you a leaflet about them now; just say Style C-G Flexitallic Gaskets.

"Flexitallic" Reg. U.S. Pat. Office

Representatives in Principal Cities

FLEXITALLIC GASKET CO., 8th and Bailey Streets, Camden, N. J.

Originators of Spiral Wound Construction



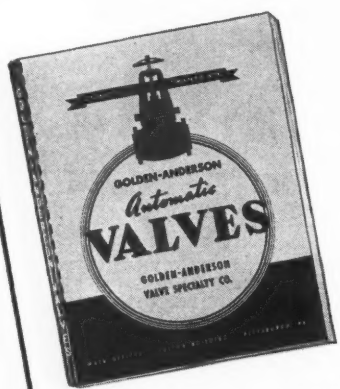
Golden-Anderson

TRIPLE-ACTING NON-RETURN VALVE

- **Automatically cuts in a boiler whenever its pressure equals line header pressure.**
- **Isolates a boiler automatically whenever its pressure, from any cause, is lower than line-header pressure.**
- **Prevents steam flow from boiler in event of sudden drop below boiler pressure by means of differential shot pilot valve functioning.**

The GOLDEN-ANDERSON Triple-Acting Non-Return Valve is today protecting thousands of boiler rooms against the disastrous effects of a bursted tube or other boiler rupture by automatically cutting off the inflow of steam from the whole line the instant the rupture occurs. Get this life and property protection for *your* boiler room! Non-Return Valves are supplied in Angle, Globe and Elbow patterns in sizes 2½" to 12" . . . a size and type to meet every plant requirement.

Write today for detailed information on the G-A Non-Return Valve. Complete operation and construction data will be sent immediately.

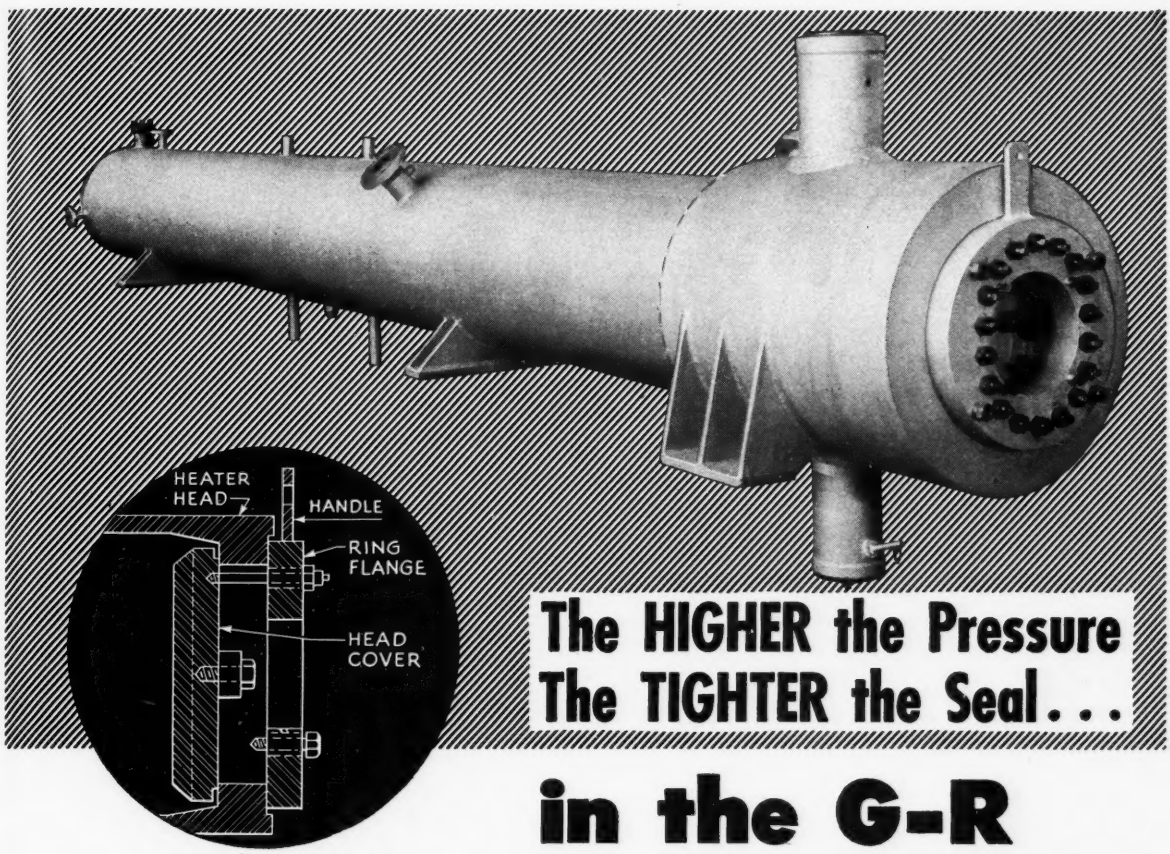


Copies of this latest catalog, containing full descriptions of all G-A Specialty Valves, will be sent on request. Write for yours today!

GOLDEN-ANDERSON

VALVE SPECIALTY COMPANY

1300 FULTON BLDG., PITTSBURGH, PENNSYLVANIA

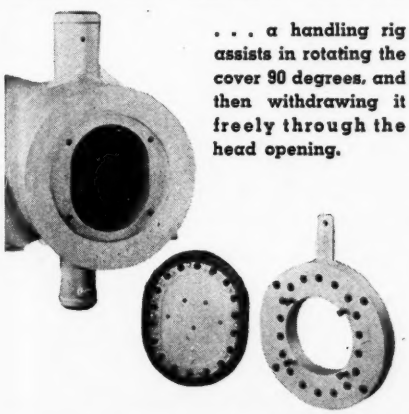


The HIGHER the Pressure The TIGHTER the Seal . . .

in the G-R

Type M BLEEDER HEATER

READILY REMOVABLE



. . . a handling rig assists in rotating the cover 90 degrees, and then withdrawing it freely through the head opening.

In this exclusive design of bleeder or stage heater, the water pressure *helps* to hold the cover tight against the head. Therefore, heavy bolts or studs are not required to maintain tightness, as in most designs; and leakage or seepage need never occur.

This design combines simplicity with effectiveness on high-pressure service, for it includes only two parts; the "manhole" cover and a ring flange. Other G-R designs with similarly advantageous features are available for moderate and low pressures. Bulletin on request.

THE GRISCOM-RUSSELL CO.
285 MADISON AVENUE, NEW YORK 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

Sound the Alert!

MANAGEMENT
LABOR

—for the 5th War Loan drive during June and July. The need for the 5th War Loan is immediate, crucial. For impending events may make the 5th the supreme financial effort of the war.

The U. S. Treasury has set the overall goal at $16,000,000,000 — $6,000,000,000 from individuals alone. This is the biggest sum ever asked of the American people—*and it must be raised.*

That's why the U. S. Treasury asks Management and Labor to sit down together and organize—NOW!

For organization—good organization—has been responsible for the excellent showing of the payroll market. And its most important single superiority has been personal solicitation—desk to desk, bench to bench, machine to machine personal solicitation. 71% of all persons on payroll deductions were solicited for the 4th War Loan.

Now, to personal solicitation, add the sales incentive of a definitely established plant quota. Build your campaign around a quota plan. Set up departmental goals. Stress percentage of participation figures. Stimulate group enthusiasm.

In planning your quota campaign, work in close cooperation with the Chairman of your War Finance Committee. Everything is set to make the 5th War Loan drive a huge success—with your help!

(Note: You've read this message. If it doesn't apply to you please see that it reaches the *one* person who can put it in action!)

Here's the Quota Plan:

1. Plant quotas are to be established on the basis of an average $100 *cash* (not maturity value) purchase per employee.
2. Regular Payroll Savings deductions made during the drive accounting period will be credited toward the plant quota.
3. 90% of the employees are expected to contribute toward raising the cash quota by buying extra 5th War Loan Bonds: 1—Outright by cash. 2—By extra installment deductions. 3—By extra installment deductions plus cash.

Example: **JOHN DOE Mfg. Co.** — 1,000 Employees

1,000 employees x $100 Regular Payroll deductions during the eight weekly payroll Accounting Periods of June and July = $100,000 Cash Quota

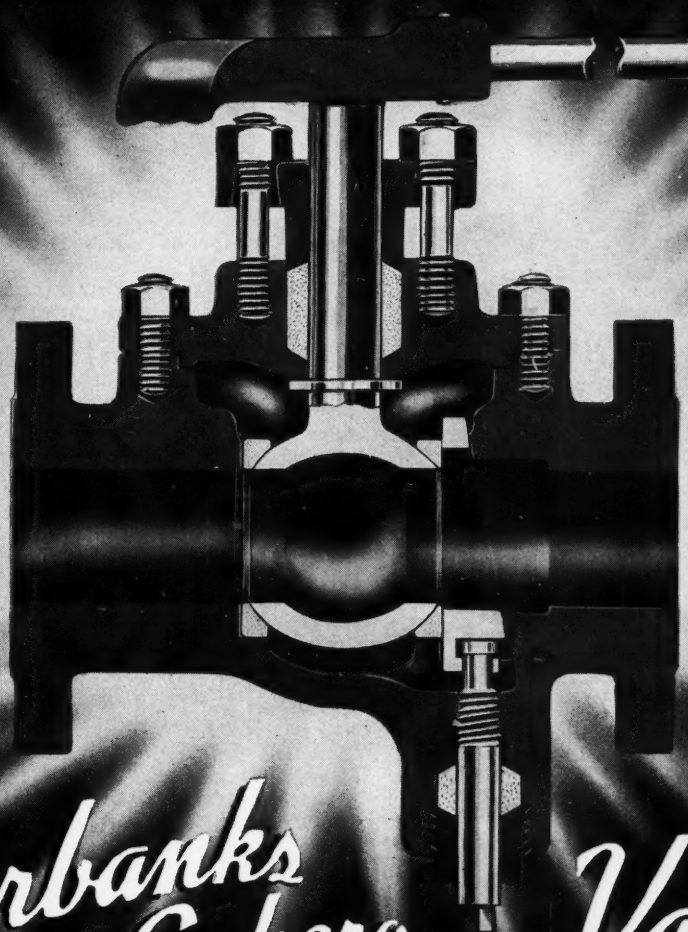
30,000
$70,000 (to be raised by sales of extra Bonds to at least 900 employees)

ORGANIZE • SOLICIT • DELIVER

The Treasury Department acknowledges with appreciation the publication of this message by

POWER PLANT ENGINEERING

★ ★ *This is an official U. S. Treasury advertisement—prepared under the auspices of Treasury Department and War Advertising Council.* ★ ★



Fairbanks Sphero Valves

End Blow-off Troubles

When a full-flow, quick-acting valve is required, specify "Fairbanks Sphero" patented valve.

Instead of the usual wedge or disc, a revolving ball is used which cuts through solids and liquids and wipes the seating surface clean. Can be opened or closed with a quarter turn of the lever handle.

Write for Catalog No. 42 and name of our nearest distributor.

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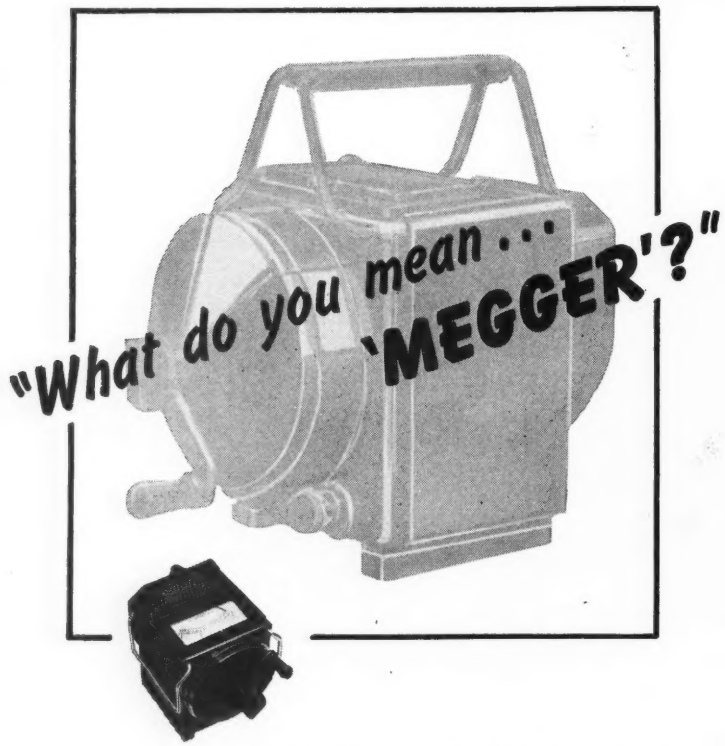

Although "Megger" testing instruments are sometimes referred to as "Meggers," there is actually no such thing as "a Megger." Why? Because the name "Megger" is a trade mark which is registered in the U. S. Patent Office and it applies in this country *only* to certain electrical instruments that are sold exclusively by the James G. Biddle Company. • These facts are re-stated here to prevent misunderstandings that may arise from careless or misleading use of the term "Megger." • The more widely used of these "Megger" instruments are listed below. Full information will be furnished on inquiry.

"Megger" Insulation Testers.....*Bulletin 1735-PE*
"Bridge-Meg" Resistance Testers.....*Catalog 1685-PE*
Midget "Megger" Testers.....*Bulletin 1690-PE*
Midget "Megger" Circuit Testing Ohmmeters.....*Bulletin 1495-PE*
"Megger" Ground Testers.....*Catalog 1645-PE*
"Ducter" Low Range Ohmmeters.....*Bulletin 1635-PE*

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JAMES G. BIDDLE CO. • 1211-13 ARCH STREET PHILADELPHIA 7, PA.

New 100,000-lb-per-hr Boiler Saves $100 a Day In Fuel

(*Continued from page* 71)

This was not successful because of two conditions: (1) the formation of small islands in the fire where all burning completely stopped, causing piling up of green fuel on the grate; and (2) the difficulty of removing the ash from the furnace as fast as it accumulated. Our experiments indicated, however, that if the ash can be removed from the furnace fast enough to keep the ash bed reasonably thin at the front of the stoker grate, it might be possible to burn 100 per cent breeze. We have been able to burn the coke and coal mixture at all loads down to 25 per cent of maximum rating.

The mixing of the coke breeze and coal is done merely by dumping a fixed weight of coal into the weigh larry and then dumping on top of that a fixed amount of coke breeze. No attempt is made to mix the two fuels uniformly, and the feeding through the stoker hoppers is not uniform in mixture. Intermittently feeding a small amount of coal is sufficient to maintain satisfactory operation; however, we are planning a method that will give uniform, continuous mixing of the two fuels in the future.

Operation to date with the coke breeze indicates that grate deterioration occurs and that they will possibly require a renewal about once each year. However, this is not a big item when compared to the saving we are able to make with the coke breeze.

No changes are made to the combustion control system or the stoker when changing from 100 per cent coal to the coal-and-coke breeze mixture other than increase the relative feeding rate to compensate for the lower heat content of the coke.

Instrument Charts

The charts, Figs. 15, 16 and 17, show pertinent operating information on the boiler unit. That the boiler unit handles very wide swings in load without upsetting the fuel-air ratio is shown very clearly in these charts.

The uniform and steady CO_2 maintained with the varying loads shown by the steam flow charts indicates the excellent overall performance of the combustion control system and the continuous-cleaning spreader stoker. The stable water level indicates good circulation and good distribution of heat absorption in the boiler.

Table I shows the summary of

The Army's Answer to a "MUST!"

"Thunderbolt"—said to be the most powerful single seat fighter in the world, with four .50 caliber fixed machine guns mounted in each wing panel, a flying speed of more than 400 m. p. h.—and a diving speed greater than the speed of sound.

"Musts" are constant in industrial, as in military achievements. And the only "stock-bin" out of which "musts" are solved is the stock-bin of experience and specialized application. **POWELL**, for nearly one hundred years, has made valves, and valves only . . . valves for all flow control requirements . . . valves for the "must" requirements in all fields of industry . . . in war or peace . . . through ten decades of industrial progress. Our experience in producing *the* valve to do *the* specific job—"to meet the must"—is yours on request.

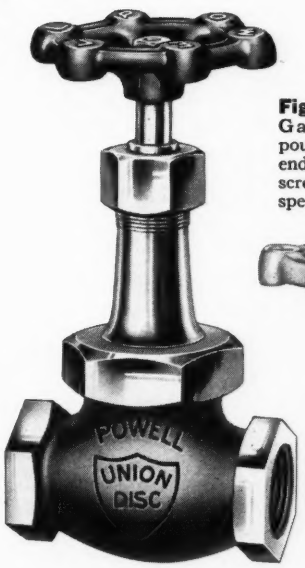
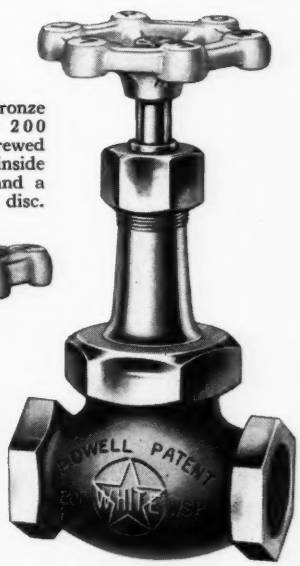


Fig. 150 (above)—Bronze "Union Disc" Globe Valve for 150 pounds W. P. Has screwed ends, union bonnet, and renewable vulcanized composition disc—especially suitable for throttling service—for controlling low-pressure steam, oil, water, gas, etc.

Fig. 375 (below)—Bronze Gate Valve for 200 pounds W.P. Has screwed ends, union bonnet, inside screw rising stem and a special hard bronze disc.



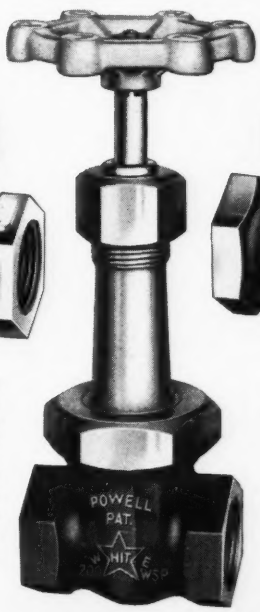


Fig.1708(above)—Bronze Globe Valve for 200 pounds W.P. Has screwed ends, union bonnet, renewable seat and regrindable, renewable hard bronze semi-cone plug type disc—especially suitable for throttling service—for controlling low-pressure steam, oil, water, gas, etc.

The Wm. Powell Co.

Dependable Valves Since 1846

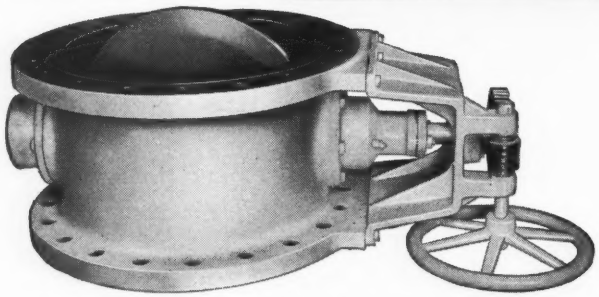
Cincinnati 22, Ohio

POWELL VALVES

HOW TO ORDER

R-S Cast Steel Butterfly Valves

No. 53
150-pound steel valve with raised face. Hand wheel operated. Extra rugged construction.



R-S Cast Steel Butterfly Valves are divided into two classes. Class A are lightweight, close coupled 15-pound valves with series 15 flanges. For limited pressure drops, ball bearings can be used. Class B are constructed for heavy duty service. The face-to-face dimension is greater than that of Class A valves, permitting the installation of oversized shafts, bearings, stuffing boxes, etc. for higher working pressures and temperatures.

In ordering any R-S Butterfly Valve, regardless of type, class or service for which it is to be used, it is essential to furnish the following information:

No. 610
Heavy-duty air motor operated steel valve equipped with hand jack, mercury switch, hand wheel declutching unit and dual stuffing box.

1. Size of valve and type of flanges.
2. Nature of gas, liquid or other material to be shut-off or controlled.
3. Line pressure and pressure loss in valve.
4. Rate of flow and operating temperature.
5. Method of control (hand lever, chain lever, hand wheel, chain wheel, extended shaft for inaccessible locations or power operation).

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VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Avenue • Phila. 44, Pa.

15 to 900 psi

R-S Streamlined BUTTERFLY VALVES

a 10-hour test, burning West Virginia dock coal. Table II shows a tabulation of data such as pressures, drafts, etc.

To meet the final objectives of this modernization program, the highest standards must be maintained in engineering, design, reliability, ease of operation and attention to detail. During the design and construction of this boiler unit, there were many temptations to change something in the interest of "making it easier." These changes would have compromised the design and performance would have suffered. No outstanding engineering job can be done without encountering problems and good design should not be compromised just to make it easy, if highest performance is to be maintained. This principle was followed in the design and construction of the boiler unit described here.

The total installed cost of this boiler unit, *ready to operate and including painting*, was approximately $130,000. The savings in fuel alone over the cost of operating the old boilers will pay for the new boiler unit in approximately 3½ years.

Unusually good co-operation between the manufacturers and the company's engineers existed throughout the boiler project; this unquestionably is largely responsible for the fine final performance of the unit. In appreciation, the company sponsored a party for the engineers and representatives of the various companies who helped to build the unit, after its completion.

Supervision of design and construction of the new unit were carried out entirely by the engineering staff of J. I. Case Co., with the cooperation of equipment suppliers, as noted above, all under the direction of the writer. Frank Palermo was in direct charge of all design and construction work, assisted by Lawrence (Legs) Meissner, who is now in the U. S. Navy. Charles W. Hagie is chief operating engineer of the Tractor Works power plant.

H. V. Interconnection Made Reliable By Single Pole Switching

(*Continued from Page 79*)

needs for power transfer over this line section. As pointed out above, the line design is such that single line-to-ground faults will predominate, and excellent continuity of service is anticipated. During multi-phase faults the reclosing scheme is arranged so that all three

How to tube a heat exchanger for new high temperatures ... new high pressures

If you were to look inside the feedwater heaters of the latest high pressure power plants, you would see how one of the major problems of high temperature–high pressure operation was solved in constructing these units.

The problem was to find tubing material that could withstand higher temperatures and higher pressures than had ever been tried before.

The tubing had to be stronger at elevated temperatures. It had to be corrosion-resistant to maintain a smooth surface and prevent accumulation of sludge and salt deposits. It had to have good heat-transfer properties. It had to be hard and tough to resist erosive wear. And it had to be ductile, so that it could be readily expanded into tight head connections.

In checking over possible materials, three groups of engineers, working independently on this problem, came out with the same answer: *Monel has the combination of properties necessary to meet the requirements.*

★ At the Twin Branch plant of Indiana and Michigan Electric Company, subsidiary of the American Gas and Electric Service Corp., Monel tubing was installed in a pre-heater handling 550,000 pounds of water an hour at 3200 pounds pressure per square inch—under external temperature of 637° F.—feeding a boiler operating at 2500 pounds steam pressure!

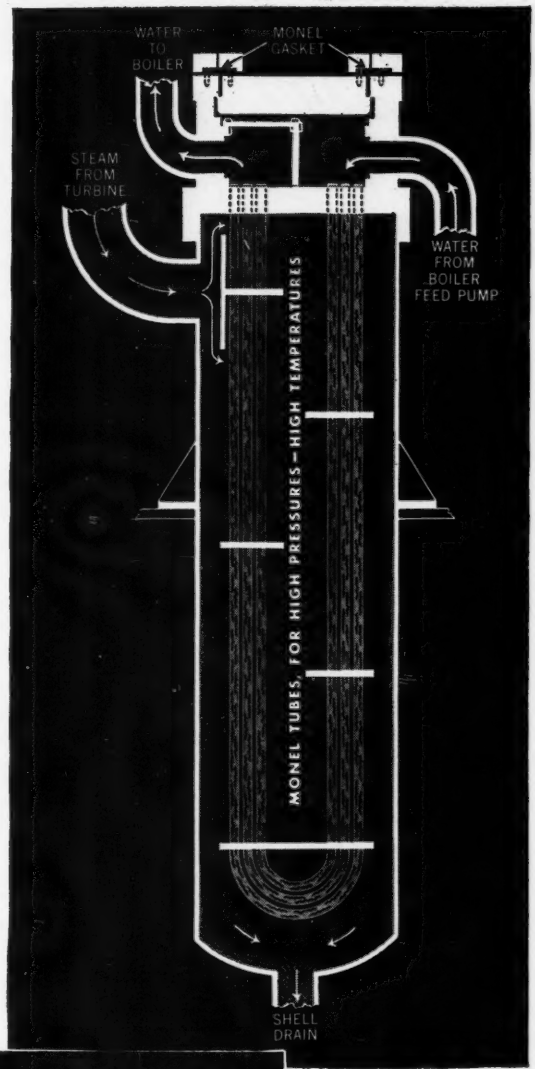
★ In Providence, R. I., the Narragansett Electric Company put one new high pressure boiler to work generating three times the power formerly obtained from eight low pressure units... using Monel tubing under external heat of 700° F., internal pressure of 1300 psi.

★ In the Oswego plant of the Central New York Power Corp., Monel heater tubing was installed to operate under 2000 pounds water pressure, at an outside temperature of 770° Fahrenheit.

Recently, these installations were examined after 3 to 4 years' service and their performance has confirmed the choice of Monel as a practical answer to the problem—the Monel tubing was still operating perfectly.

If you are considering the installation of high temperature-high pressure equipment, here is one problem that has already been solved for you. For a more complete discussion of the problems encountered and overcome in the Providence, Oswego and Twin Branch installations, write for a reprint of the article "27 TIMES THE POWER OUTPUT..." It includes the table of maximum allowable design stresses for non-ferrous materials taken from the proposed A.S.M.E. Boiler Code, and additional information about Monel heat exchanger tubing.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street **New York 5, N. Y.**



EXPANDING TUBES *into the head of a pre-heater at Twin Branch. The excellent working properties of Monel are here in evidence. Monel tubing is ductile...can be expanded into snug-fitting durable connections with the head.*

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★ Dart bodies and nuts, made of high-test malleable iron, help Darts resist rough handling and rust.

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P. S. If you can't find enough Darts to meet your needs, see your supplier for new Darts.

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DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

poles can trip and reclose, and inspection of Table I shows that even then the power limit is 94 megawatts; high enough to meet most operating conditions.

Thus, with high-speed, single-pole switching applied to these five new transmission lines, a very small increment in investment has made possible a degree of reliability unsurpassed in single-circuit systems. In fact, it is expected that the service continuity of these lines should approach that usually associated with multi-circuit lines.

References

(1) "High-Speed Single-Pole Reclosing," by J. J. Trainor, J. E. Hobson, and H. N. Muller, Jr. AIEE Transactions, Vol 61, February, 1942, pages 81-87.

(2) "Relays and Breakers for High-Speed Single-Pole Reclosing," by S. L. Goldsborough and A. W. Hill. AIEE Transactions, Vol 61, February, 1942, pages 77-81.

(3) "Single-Pole Fault Clearing for Greater Stability," by J. E. Hobson and H. N. Muller, Jr. Westinghouse Engineer, February, 1942, pages 23-25.

(4) "Keeping the Line in Service by Rapid Reclosing," by S. B. Griscom and J. J. Torok. The Electric Journal, Vol 30, May, 1933, pages 201-204.

Corrosion of Condenser Tubes By Ammonia

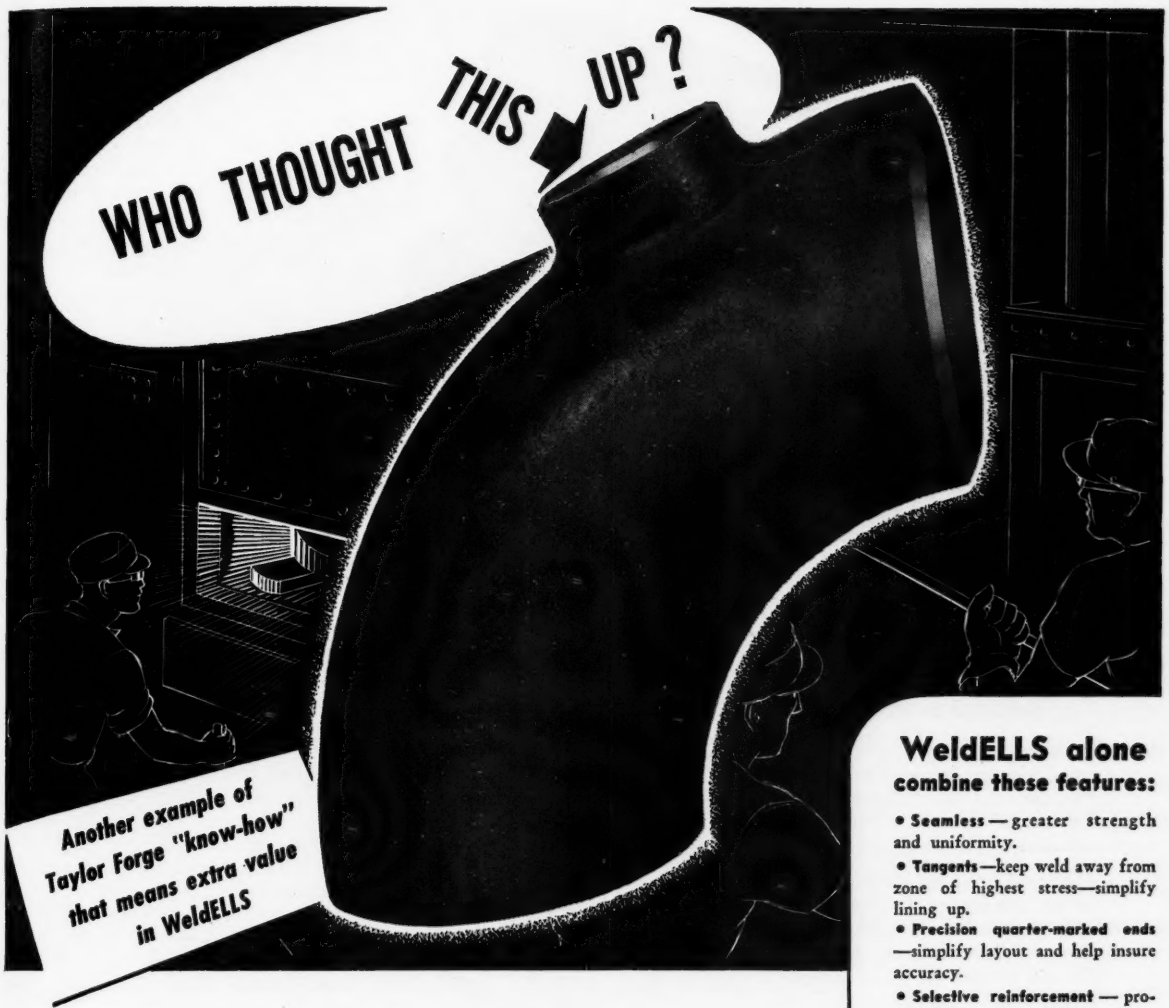
(*Continued from page* 87)

ing period, the unit operates at atmospheric pressure. Late in 1939 a very bad circulating water condition caused several outages each week. Immediately following this period, a large number of tubes failed.

According to McKay and Worthington "Damage to metal from exposure to cyclic, or fatigue, stresses may be intensified very markedly by exposure at the same time to a corrosive atmosphere or solution. In cyclic stresses of the nature of simple repeated bend . . . it is the surface layers of the metal that are most highly stressed. Corrosion likewise involves the surface layers first. The damage known as corrosion fatigue results from both influences.

"Two factors in the progress of corrosion fatigue damage are well to keep in mind. One is that the corrosion of metal lowers its fatigue resistance. The other is that fatigue stresses accelerate corrosive action. Consequently, metal corroded will be found to have subsequently a lower fatigue limit than uncorroded, and therefore even greater damage results where corrosion and fatigue are at once present.

"Corrosion in the absence of



YOU would almost think the pipe designer had gone out of his way to figure out this one—a special, seamless, seven-inch carbon-moly WeldELL with an integrally formed 3-inch outlet. But of course this special fitting was needed, and actually it isn't as special as many other problems which are put up to us by engineers who have found that we have a way of licking them.

For every "special" that is required a thousand standard fittings are needed, of course. But it is the "know-how" acquired through years of solving problems like this that enables us to provide so many "special" features in WeldELLS—features that mean added value and better engineering.

One good example of this is the uniform strength engineered into WeldELLS through proper distribution of extra metal where stresses are higher. Another is the extreme dimensional accuracy which results from special truing operations. Tangents, too, require a special process which is justified only because it results in a better fitting.

In fact, if you will check the list of features opposite, we believe you will agree that only the specialized "know-how" and facilities of Taylor Forge could give you these fittings that . . . *"have everything!"*

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

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The Henszey Flow Indicator has round wide use in many war industries where the accurate knowledge of the rate of flow of a liquid is a necessity.

The liquid enters the indicator below the plunger forcing the plunger upward. Slots in the side of the plunger allow the liquid to pass. Increased flow will increase the lift, exposing a greater area of the slots so that the lift of the plunger is in proportion to the rate of flow of the water.

Henszey Indicators accurately register the flow from zero to 100%. The graduations on the dial are uniformly spaced from one end to another and read direct. The entire instrument can be installed right in the pipe line.

Consider Henszey Flow Indicators for your "tough problem". Installations are satisfactorily performing in nationally known paper mills, chemical plants, petroleum refineries, milk condenseries and other war industries.

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cyclic stresses is normally superficial and confined to the surface of the metal itself. Corrosion simultaneous with fatigue stresses leads to pronounced penetration, as evidenced by cracks, with the result that damage due to corrosion fatigue may be—and often is—great."

Suggested Plans for Reducing Corrosion Rate

A number of plans for reducing the corrosion rate were discussed. These included:

1. Increasing injection water temperature to a minimum of 45 F.
2. Reduction of ammonia content in makeup water.
3. Reduction of ammonia content of condensate.
4. Installation of spray heads above tube bundle, at inlet end, to spray condensate over tubes and tube sheet for purpose of diluting concentrated aqueous ammonia.
5. Changing air offtake nozzle from end zone to outside channel along the shell.
6. Reducing condenser outages.
7. Retubing with metal more resistant to ammonia corrosion.

Action Taken on the Various Plans

Injection water temperature was increased during the winter months by returning a portion of the discharge water to the pump suctions. At present the return valve is hand operated. For perfect control of injection water temperature, a motor-operated valve controllable from the engine room should be installed.

No suitable method of reducing or eliminating the ammonia in makeup water has been found; that is, the fixed charges and/or operating cost of known methods would, in this case, exceed the cost of condenser tube replacements. Methods considered were: (1) Carbonaceous Zeolite Treatment or Resin Type Ion Exchanger; (2) Chlorine Treatment; and (3) Deaerating and Deammoniating Heaters. Chlorine treatment would be excessive because of the amount required to satisfy the iron content of the raw water.

Some ammonia is flashed from water in the hot process softener but most of this is redissolved by condensate in the vent condenser. This drip should be wasted.

The only material reduction in the ammonia content of condensate is effected by the air removal jets of the condenser in question. The drip from the aftercondenser of the jet is now discharged to the sewer. As much as 180 ppm (NH_3) of ammonia has been found in this drip

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Whatever your needs in industrial or warning signals, consult Foster on sirens. Ask for Bulletin 29.

Type 45 Siren, Manual Control. With 18" horn, this siren produces non-directional sound level of 125-130 decibels at 100 feet. Available with remote electric control.

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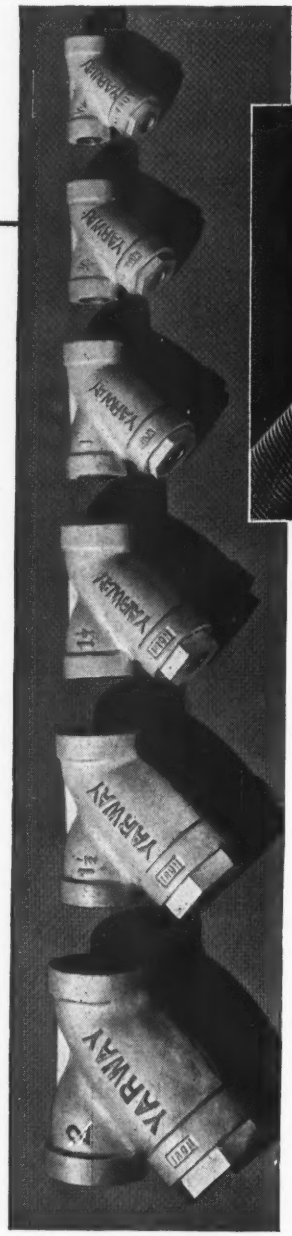

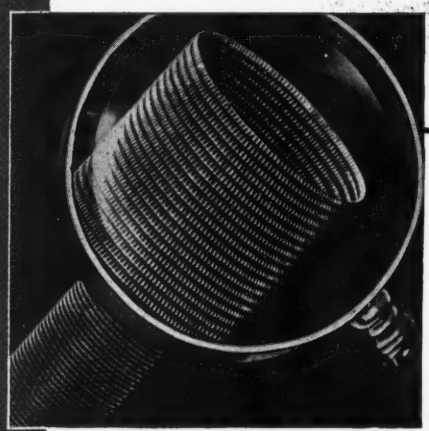

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YARWAY STRAINERS

and is equivalent to about 25 per cent of the ammonia entering the turbine. No attempt has been made to waste the drip from the jet intercondenser.

The idea relative to spraying condensate over the tubes has not been carried out. It is possible that such spraying would do more harm than good by increasing the amount of ammonia redissolved and by extending the active corrosion over a larger area.

Air Offtake Connections Added

Recently two auxiliary air offtake connections were added. The shell was tapped near the reversing end to permit removal of gas and vapor from the air offtake channel, thus by-passing the special air cooling section. The new and old air offtake connections are so valved that either or both may be used. The new connections have been used through the 1943-1944 winter season with no loss in vacuum. It is very probable that the old system will be necessary during summer months. The purpose of this change was to decrease the volume of vapor and corrosive gases drawn back into the end zone (1-a of Fig. 3), and thus reduce the amount of after-condensation and the degree of ammonia concentration.

Installation of Tubes for Testing

In May, 1940, the zone of severe corrosion was retubed. At that time no data were available for judging comparable life of various tube alloys with ammonia the corroding agent. Preliminary investigation indicated the use of low copper alloys. However, the low copper alloys had failed in previous years, due to dezincification. For test purposes arsenical copper was again used with the exception of 48 special test specimens.

A total of 442 tubes were removed and new tubes installed as shown in Fig. 9. Tubes designated 1-28 inclusive were located in the area where the original tubes first failed. One each of the various types were to be removed at regular intervals for examination and comparison.

Two 15-in. x ⅝-in. zinc test rods were inserted in the seventh row down. Twelve inches of each rod extended past the inner face of the tube sheet and 2 in. were exposed to circulating water. The purpose of using these zinc specimens was to prove whether or not the rate of corrosion varied with the load and circulating water temperature. After four months of summer conditions the specimens were removed. Corrosion was negli-

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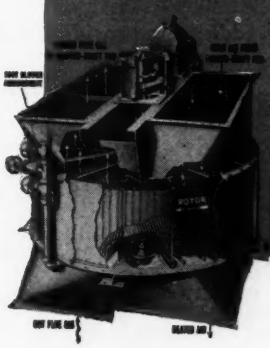
In the Ljungstrom, a compact heating unit soaks up heat in the gas chamber and liberates it into the entering air. Its efficiency is unusually high for its size and weight. In many cases, the weight of a Ljungstrom Preheater will be ⅓ to ½ that of other types for the same heat recovery.



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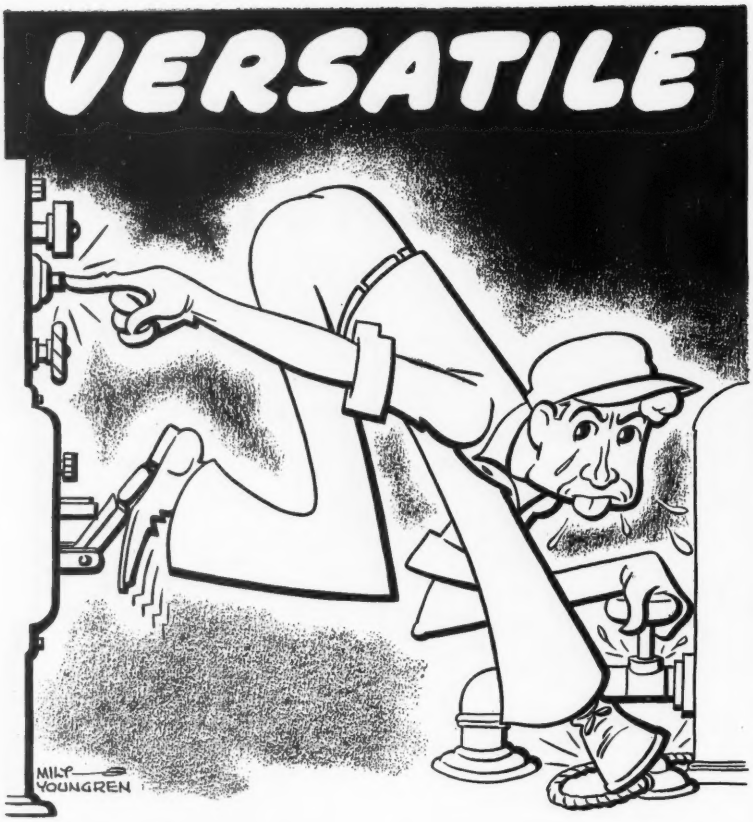

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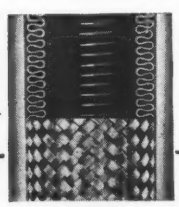
In addition to providing maximum flexibility, REX-WELD is highly resistant to fatigue, handles burst pressures to 14,500 p.s.i. and temperatures to 1000° F., remains air-tight longer, is leakproof even after hard usage, can be used for liquids that are searching and will withstand prolonged flexing.

Chicago Metal Hose Corporation manufactures a type of flexible tubing to meet every requirement. Our engineers will be glad to recommend the type best suited to meet your particular requirements. Write for catalog and complete information.



REX-WELD CORRUGATED FLEXIBLE METAL HOSE

Flexible Metal Hose for Every Industrial Use

CMH CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS
Plants: Maywood and Elgin, Ill.

gible. The weight of that portion exposed in the steam side had increased slightly from corrosion products. Two new rods were inserted in October, 1940, and removed in March, 1941. Compared to the first two, these rods were severely corroded and showed a loss in weight of 0.025 per cent before removal of corrosion products. This routine was repeated with similar results, thus proving that 90 per cent or so of corrosion occurred during the period October to May inclusive.

Results from Test Section

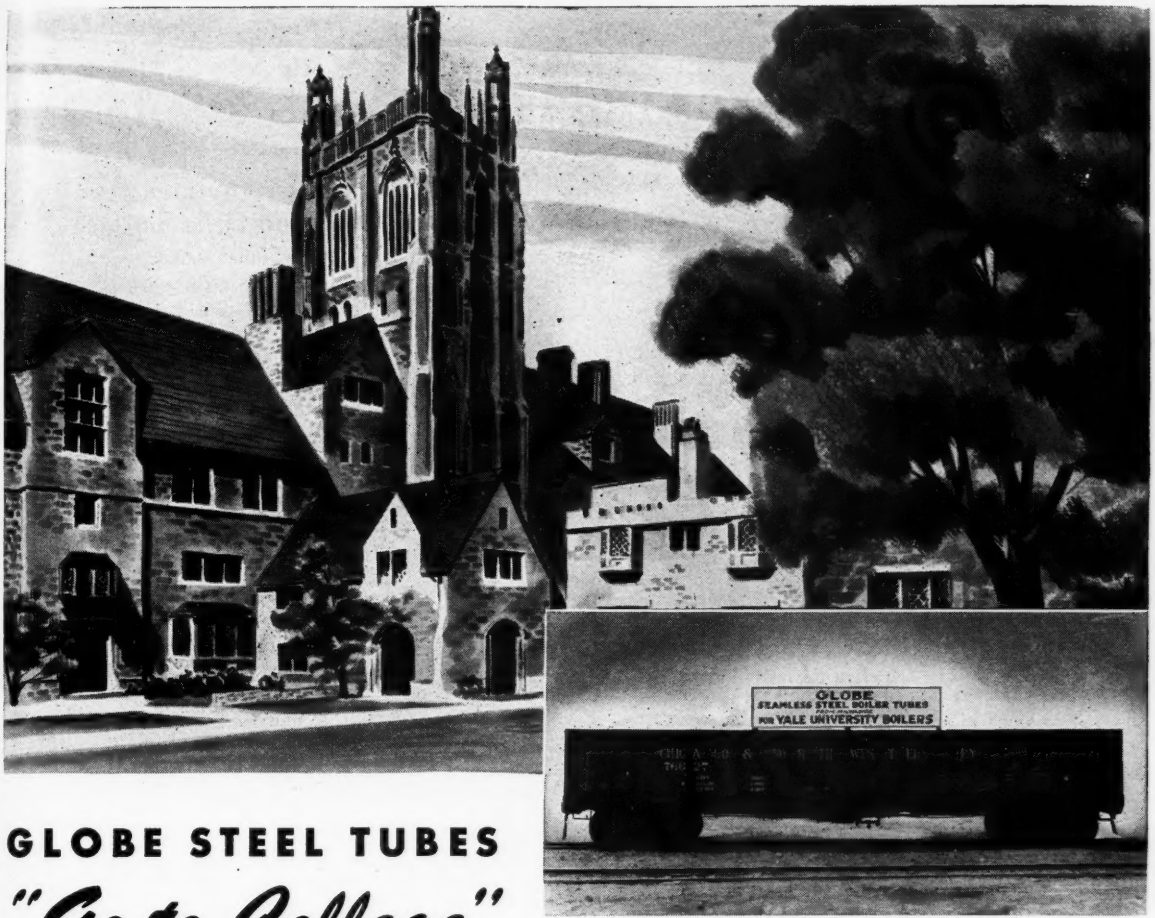
In May, 1943, five specimens were removed from the special test section. Although data from one set of specimens are not sufficient for definite conclusions, they can be used for a general statement. The first 6 in. of each specimen was weighed and wall thickness gaged at the point of heaviest corrosion. Loss in weight for the first 6 in. of each type was: Stainless Steel, 0.2 per cent; Arsenical Copper (Avg) 18.85 per cent; Special Admiralty (Avg) 4.95 per cent. Gaged at the point of deepest erosion, wall thickness was as follows:

	Stainless	Admiralty (Avg)	Arsenical (Avg)
Original Wall Thickness	0.0475″	0.0488″	0.0458″
Final Wall Thickness	0.0455″	0.0387″	0.0315″
Difference	0.0020″	0.0101″	0.0143″
% Metal Lost	4.2	20.7	31.2

Metal loss does not tell the full story. Intercrystalline penetration of the remaining metal may differ and the time of failure be much nearer than indicated by metal loss. Unfortunately, micrographic studies were not made. However, actual failure of tubes began soon after the above specimens were withdrawn. In December, 1943, tubes again began to fail. At first these failures were confined to two rows immediately below the retubed area. However, in January, 1944, the new tubes began to fail. To date, all failures have been arsenical copper. Up to March 15, 1944, 22 new tubes had failed in addition to 36 original tubes.

Failure of the last set of tubes began 45 months after installation, as compared to 27 months for the original tubes. This is an indication of the progress made in combatting corrosion other than changing to a lower copper alloy.

In May, 1944, the tubes in the zone of failure will be replaced. This time one of the special Admiralty type of tube will be used. All Admiralty tubes and the stain-



GLOBE STEEL TUBES

"Go to College"

"The halls of learning" like Yale and Chicago Universities have at their command engineers and laboratories qualified to make all the critical tests on material bought for their own use. Globe Seamless Steel Tubes have gone into the boilers of their powerhouses to insure long and continuous operation at low maintenance costs.

Globe Seamless Steel Tubes of carbon, alloy, or stainless steel are made in a plant devoted for more than 30 years exclusively to the manufacture of steel tubing. Every order, large or small, is a special order and is checked at each stage of our exacting process of manufacture. The finished tubes are inspected with the most up-to-date testing devices to insure accurate filling of customer's specifications.

Globe Steel's customers have at their service our large technical staff and completely equipped laboratory. We will be glad to aid you in selecting steel tubing to meet your particular requirements.

★ STAINLESS TUBES
★ BOILER TUBES
★ GLOBEIRON TUBING
★ GLOWELD TUBES

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GLOBE STEEL *Tubes*

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GLOBE STEEL TUBES CO., *Milwaukee 4, Wis., U.S.A.*

Just a drop of water-

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or is it?

Although specially treated for use in your water consuming equipment, it may still contain a sufficient amount of water hardness to cause boiler scale, priming, foaming, pitting or corrosion or caustic embrittlement.

There's no question about feed water conditioned by nature's own method discovered in the new TECHNICAL Water Conditioning System . . . a perfect balance of water's mineral content with correct, natural *organic substances.*

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TECHNICAL is a proven, natural system of individual formulas to fit each and every water type. It provides a special balance of water properties that definitely overcome scale, foaming, pitting, corrosion, priming, caustic embrittlement characteristic of boilers and condenser covering systems.

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less steel tubes installed in 1940 will be left, unless failures occur before May. When these fail, we will have practical data for comparing the expected life of the various alloys.

Pumps—The Heart of Big Inch and Little Big Inch

(*Continued from Page* 120)

ing tools for adjustments.

Bearings are two sleeve bearings with a ball thrust bearing, the same as on the crude line pumps. Oil circulates through the sleeve bearing and around the ball bearing, with only part of the oil going through the latter. Since no bearing cooling water would be available at most of the pumping stations and the use of air heat exchangers would involve added equipment, the bearings are cooled by the gasoline handled by the pump.

The bearing cooler takes gasoline leakage from the stuffing box leak-off line, the same leakage that is cooling the packing, hence no gasoline is wasted. The firewall stuffing box is split for ease in servicing and is made short to reduce overhang of the motor shaft extension.

Main pumps on both 24-in. crude and 20-in. products lines were supplied by Allis-Chalmers Mfg. Co. and Ingersoll-Rand Co. Motors and electrical control equipment were supplied by General Electric Co. and Westinghouse Electric and Mfg. Co.

For heartiest cooperation in obtaining the above data, we are indebted to: Oscar Wolfe, Chief Engineer; L. F. Scherer, Superintendent of Pump Station Construction; and A. S. Munneke, Electrical Design Engineer, all of War Emergency Pipelines, Inc. For design details of the products line pumps, we are indebted to E. L. Ross, in charge of design in the Allis-Chalmers Mfg. Co. centrifugal pump department.

Fairbanks-Morse Opposed-Piston Diesel Engines

IN ANNOUNCING its entry into the field of manufacturing Diesel locomotives for freight, passenger and dual service, Fairbanks-Morse & Co. of Chicago released information at Beloit, Wis., where the engines are manufactured, on the details of the Diesel engines which will be used to power the locomotives. These engines, which are of the opposed-piston type, went through their development stage in the 1930's but had not reached the full commercial stage when the United States

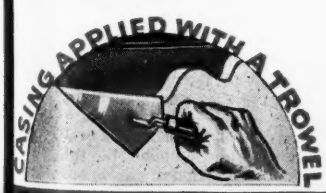
HEAT ENCLOSURES by DETRICK

What could we do to help modernize your present equipment? Our service engineers will gladly look over your setting and offer suggestions. Send print to Chicago.

As the demand developed for higher and higher furnace temperatures Detrick engineers, in at the beginning, have kept the pace offering improved construction and material application. Refractory furnace walls and arches have been designed to withstand high capacity conditions. The next step was insulated walls and arches to stop heat flow and now we have plastic casing which can be applied with a trowel which protects the insulation and gives a weatherproof finish. Each of these steps have been worked in a design that provides a maximum of effective life and a minimum annual cost.

Detrick Plastic Casing applied with a trowel fits closely in place against the insulation and provides a tight, weatherproof covering which is also neat in appearance.

The principles learned in nearly a third of a century of engineering furnace enclosures have been described in a new book which illustrates these principles as applied to many types of furnaces. Engineers who wish to bring themselves up to date on this important subject should have a copy of this book which will be sent on request.



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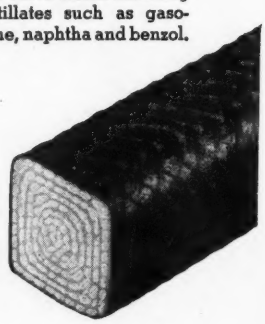
USE DETRICK INSULATION ... PLASTIC or BLOCK

BELMONT PACKINGS

FOR GASOLINE SERVICE

Belmont 6100

For rod and valve stems handling volatile distillates such as gasoline, kerosene, naphtha and benzol.



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For rods and plungers handling hot or cold oil—all temperatures.

For OIL

PACKINGS are important in every plant production program. They keep the machines of industry turning—help speed from assembly lines America's weapons of war.

AND . . . now, when equipment must stand the strain of 24-hour-a-day operations—it's vitally important that just the right packings be selected for every job.

Above are two of the many Belmont Packings especially made for petroleum services. Both 6100 and 189 are made from asbestos yarn, braided and treated with suitable lubricants for maximum operating efficiency.

Any Belmont distributor (they are located in every large industrial center) will be glad to offer suggestions on your requirements. Or write on your company letterhead for a copy of the Belmont Packings Catalog displaying the complete Belmont Line.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia

Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.

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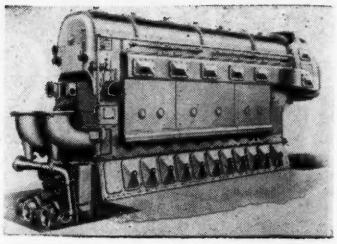

Fig. 1. Ten cylinder opposed-piston Fairbanks-Morse Diesel engine showing control side

Navy found this type well suited for powering submarines, since which time the entire production of these units has gone to the Navy for use in various types of vessels. The units, however, are readily adaptable for the locomotive and stationary applications to which the manufacturer is now turning attention.

The Fairbanks-Morse opposed-piston type of Diesel engine is new only in so far as its availability for industrial use is concerned. A decade ago, a half-dozen engines were put in service by the Southern Railway System for use in multiple-car Diesel-electric trains. All performed with general satisfaction.

The underlying principle of the Fairbanks-Morse 2-stroke cycle opposed-piston Diesel engine is the use of a plain open ended cylinder in which combustion takes place in the center of its length between two pistons which move away from each other, and in doing so uncover the exhaust and air inlet ports, thus eliminating all valves. The pistons controlling the air inlet ports are connected to the upper crankshaft while those controlling the exhaust ports are connected to the lower crankshaft, the two crankshafts being mechanically connected by means of a vertical shaft and bevel gears thereby transmitting power from the upper to the lower shaft and maintaining the proper timing between the upper and lower pistons. In reality, therefore, with a pair of pistons in each cylinder, the 10 cylinder engine becomes a 20 cylinder engine. The engines are made in various sizes having from 3 to 10 cylinders and ranging from 150 to 2000 hp.

These engines are simple and economical in operation and one of the principal factors contributing to their economy is the unidirectional flow of scavenging air.

The cycle of operation begins with the movement of the pistons from their outer dead centers. After the pistons have covered the exhaust and air inlet ports, the air between the pistons is compressed and as they approach inner dead center, fuel is injected into the combustion space where the heat generated during the compression of the air ignites the fuel. Combustion and the resulting expansion, forces the pistons outward on the power stroke, thereby delivering work to the crankshafts.

The burning and expanding of the gases continues until near the end of the powerstroke. At this point the lower piston uncovers the exhaust ports allowing the burned gases to escape to the atmosphere. The upper pistons next uncover the inlet ports and air supplied by the blower rushes into the cylinder, cleans out all burned gases and at the same time produces a whirling motion in the scavenging air which continues throughout the compression stroke and injection period and contributes to the complete combustion of the fuel. Thus during but one

SPEARHEAD OF THE ATTACK

THE FIRING LINE

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Spearheading the tremendous production of guns, planes, tanks, and ships for our fighting forces, are the boiler room firing aisles of industry! Here, steam generating units are called on to meet extraordinary operating requirements day after day with minimum maintenance.

Vogt steam boilers are making outstanding records for efficient steam generation in tough war plant service throughout the Nation.

Vogt WATER TUBE **BOILERS**

Vogt builds steam generating equipment in many types and sizes to meet every power, heating or processing requirement. Bulletins are available upon request.

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NEW, BETTER...
pump sewage and drainage by steam
...no moving parts
YEOMANS EXPELSOR
Yeomans Steam Expelsor at the Illinois Central Terminal, Chicago

This clean, sanitary, automatic method has tossed old wet-pit sewage ejection into the discard.

Do away, once and for all, with the foul, unsanitary wet-pit sewage ejector, and install Yeomans Expelsor — automatic, fool-proof, adopted by the U. S. Army and Navy for many installations.

- No more clogged pumps and the dangerous, revolting task of cleaning.
- Stops the "paper towel nuisance" — the smallest EXPELSOR handles solids that will pass through 4-inch piping.
- Hermetically sealed receiver — no noxious gases, no danger of explosion.
- No moving parts, no stuffing boxes.

Capacities 30 g.p.m. up — for air or steam operation. Write for full information.

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Here's the universal packing that can be used for any fluid or on any apparatus—economically, efficiently—tightly—simply.

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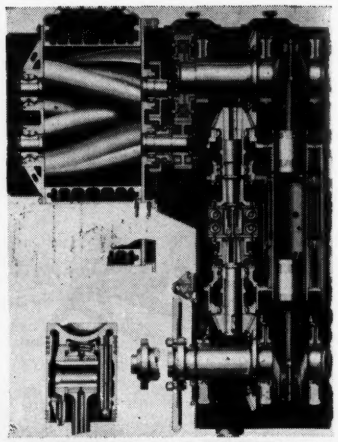


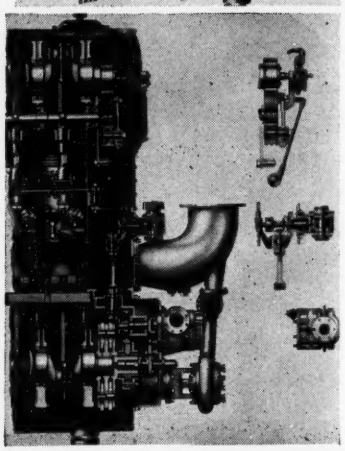


Fig. 2. (Above) Cross-section of Fairbanks-Morse opposed-piston Diesel engine, showing arrangement of opposed pistons, scavenging air blower and vertical drive. (Below) Side view of cylinder

revolution of the crankshaft, compression, injection, combustion, expansion, exhaust and scavenging take place.

The engine is a complete self-contained unit with attached rotary type blower, fuel, lubricating oil and water pumps. The scavenging air blower is of the multiple spiral lobe, positive displacement type, driven from the upper crankshaft by means of helical gears and the timing of the impellers is positively maintained by precision gearing.

The governor is of the hydraulic type and controls the quantity of fuel delivered by the injection pumps to the fuel injection nozzles.

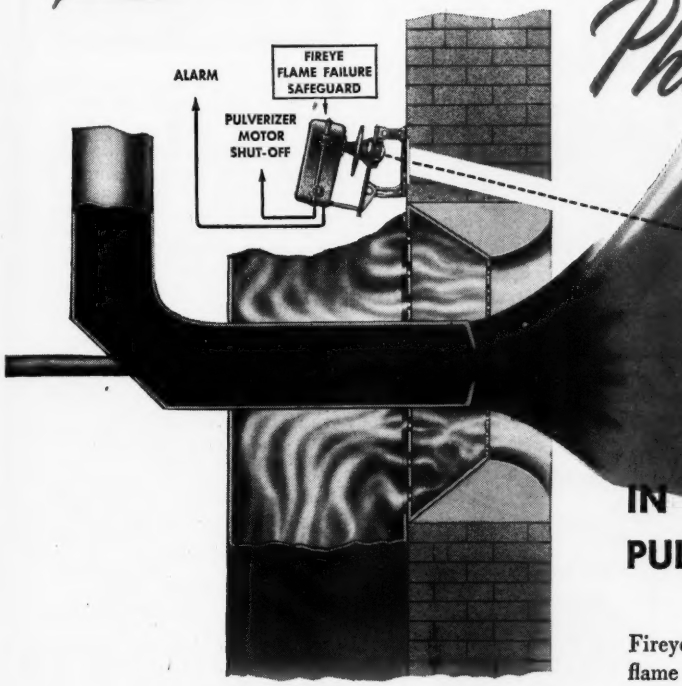
A rotary type fuel supply pump is furnished which delivers fuel from the service tank through suitable filters, to individual fuel injection pumps for the two injection nozzles in each cylinder.

Water for cooling the engine is supplied by gear driven centrifugal pumps. The lubricating oil pump is of the herringbone gear type and furnishes lubrication for the entire engine including main bearings, piston pin bearings, camshaft bearings, etc., thereby eliminating any hand oiling.

Diesel Engine Tests

INTERESTING test results of a large Nordberg Diesel engine have recently been released by the Nordberg Manufacturing Co., Milwaukee, Wis. Engines of this type, it is stated, are available in sizes from 4000 to 8000 shaft

fireye PREVENTS EXPLOSIONS *Photoelectrically*



IN OIL, GAS, OR PULVERIZED COAL BURNERS

Fireye acts with the speed of *light*—the light of the flame itself, watched at all times by the photoelectric eye. If the flame fails, Fireye prevents explosion by shutting off the fuel instantly, and sounding an alarm.

Explosions in pressure-fed heating equipment employing oil, gas or pulverized coal cause millions of dollars' damage annually. These explosions are the result of *delay*—a few vital seconds lost between flame failure and fuel shut-off, permitting the combustion chamber to fill with a highly explosive mixture.

Yet this dangerous interval is almost inevitable in any safety control system that depends in whole or in part upon temperature change, or flame characteristics *other than light itself*. Light is instantaneous. It acts upon the sensitive plate of the Fireye photocell, releasing a flow of electrons—a microcurrent that is amplified to operate a relay—control the fuel feed.

Only light controls Fireye. When the flame fails, Fireye shuts off the fuel *instantly*—prevents explosions. **For complete information, write for Catalog 50.**

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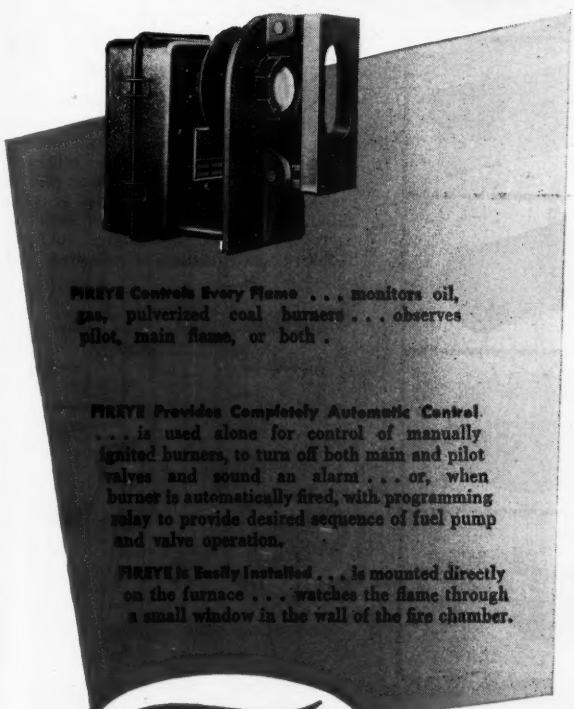
FIREYE ELECTRONIC BOILER FEEDWATER CONTROLS are floatless, maintenance-free. They maintain desired water level automatically . . . provide low-level alarm and fuel cut-off. Write for Catalog 51.



FIREYE Controls Every Flame . . . monitors oil, gas, pulverized coal burners . . . observes pilot, main flame, or both.

FIREYE Provides Completely Automatic Control . . . is used alone for control of manually ignited burners, to turn off both main and pilot valves and sound an alarm . . . or, when burner is automatically fired, with programming relay to provide desired sequence of fuel pump and valve operation.

FIREYE Is Easily Installed . . . is mounted directly on the furnace . . . watches the flame through a small window in the wall of the fire chamber.

F-1

fireye

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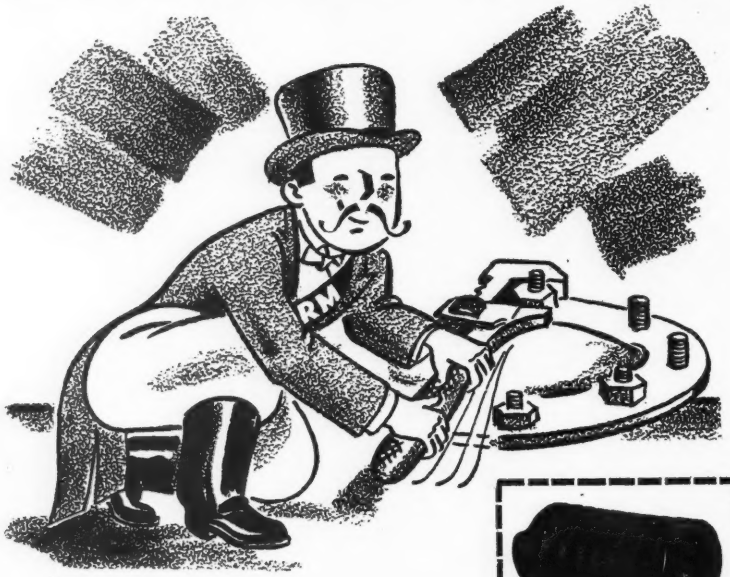
UNDERCOVER WORK IS NO SECRET *with* R/M



Terrific pressures under the forced drafts of war-production call for tough gaskets and packings. R/M performance under this strain is no secret. Their extra margin of safety has saved hundreds of hours of replacement-time in America's race for the tools of war.

High-priority demands are absorbing the greatest production in R/M history. All the packings and gaskets we can make go to meet a vital need. If your requirements are vital, too, we'll do everything possible to serve you through your regular mill-supply house.

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Makers of Packings for Every Industrial Use

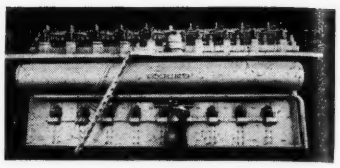


Fig. 1. Nordberg marine Diesel engine of 6000 hp given 17-day test

horsepower in 6 to 12 cylinders for single or twin engine direct drive; and also twin engine, geared single screw ship propulsion, as well as for stationary applications from 3000 to 6000 kw. This particular engine is intended for direct drive marine service.

General data on the engine tested are:

Shaft horsepower (normal) 6000
Overload capacity... 10% continuous 25% for two hours
Brake mean effective pressure at 6000 shp rating ..... 62 psi
Speed ..... 160 rpm
No. of cylinders 9
Cylinder bore and stroke ..... 29 in. by 40 in.
Type of engine ..... 2 cycle, single acting, crosshead
Type of fuel injection system .... Mechanical
Type of scavenging blower ..... Centrifugal, motor driven

The design follows the lines of other Nordberg 2-cycle Diesels of recent years, the exceptions being in the camshaft drive and reversing mechanism, and overhead location of camshaft which was necessary because of the much greater physical dimensions of this engine.

Every effort has been made to simplify designs and reduce the number of parts, and accomplishments in this respect are revealed by the sectional views and the accompanying photograph. Rugged construction is provided in the design of the separate parts and maior assemblies such as bedplate, "A" frames or columns, and

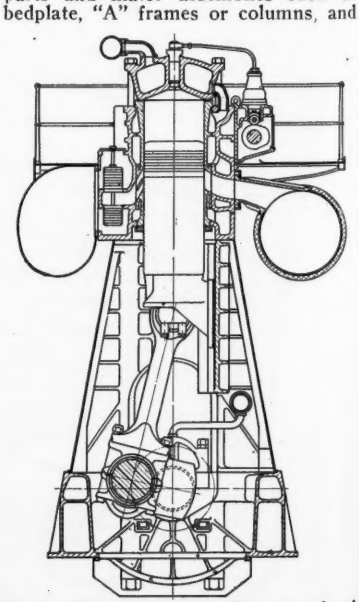
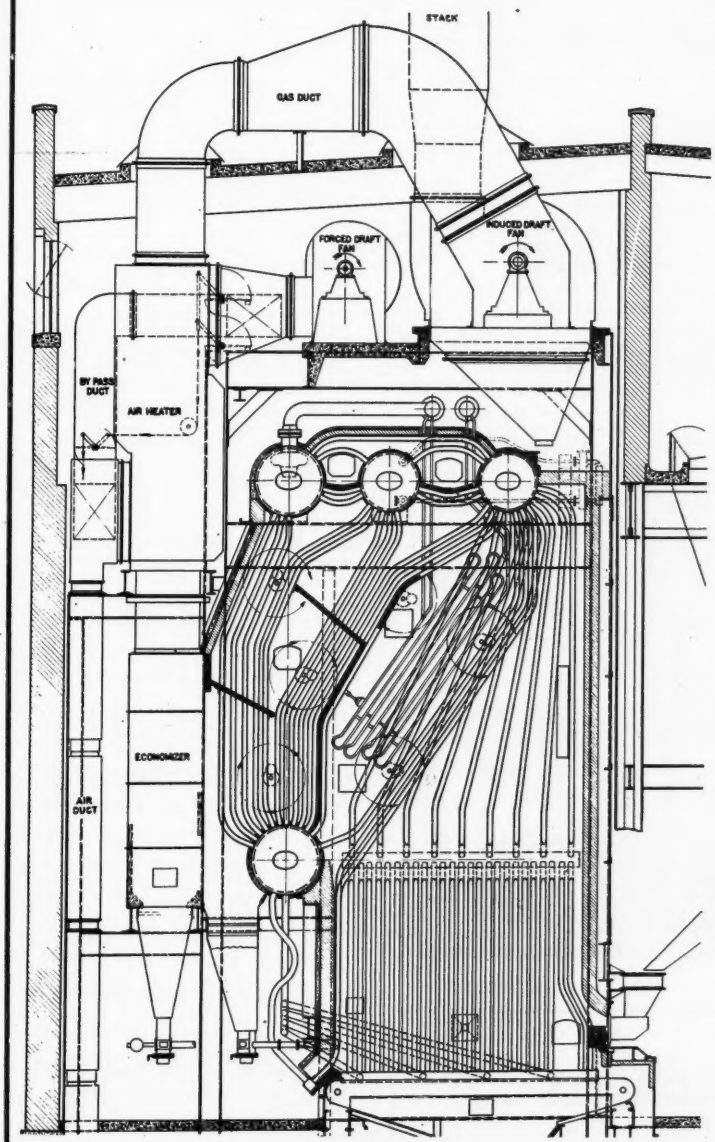


Fig. 2. Cross-section 29-in. bore, crosshead type Nordberg Diesel engine

A MURRAY STEAM GENERATOR

Selected By

THE J. I. CASE TRACTOR WORKS



THE cross section shows the MURRAY Steam Generator recently installed at the modernized Tractor Works power plant of the J. I. Case Company at Racine, Wisconsin.

This 75,000 lb. unit is designed for operation at 450 lbs. pressure, 750 degrees F. total temperature, and will carry peak loads over 100,000 lbs. per hour.

Burning a mixture of 25% coal and 75% coke breeze, the new boiler shows an average operating efficiency of 85.5%. User reports it is saving $100.00 per day in fuel.

Be sure to ask for data on MURRAY boilers. A wide range of sizes is available for your modernization or expansion plans.

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MURRAY Also Produces:

Steam Turbine Generators to 2500 KW rating

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Multistage Type "UV" Turbines

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BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

Brings added Safety
to Boiler Room Operation
Tested for SHOCK Resistance!
In repeated tests SONDERGLASSES have been dipped in hot oil 450 F, then quickly plunged in cold water without breaking . . . Besides protecting boiler room operators against the possibility of getting cut from broken gauges, SONDERGLASS gives better visibility, lasts longer, costs less per year of service than ordinary gauge glasses. Order SONDERGLASS from your steam supply man or directly from us.
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POWER PLANT ENGINEERING

cylinder blocks. Scavenging air and exhaust headers are located on opposite sides of the engine.

The crankshaft is made in two sections—one with five cranks and the other with four cranks. Each shaft section is a one-piece forging. The crank pins and journals are 20 in. in diameter. The complete crankshaft, finished all over, weighs approximately 80,000 lb and is over 41 ft long.

The camshaft drive is a train of gears incorporating a simple and ingenious reversing mechanism which has been employed over a period of many years on Nordberg reversing steam engines driving mine hoists. For stationary applications requiring unidirectional engine rotation, gears with fixed centers are substituted for the movable reversing gear assembly.

Large oil-tight, light-weight covers which are easily handled by one man enclose the spaces between the "A" frames on both sides of the engine and, when removed, admit men into the crankcase from either side of the engine for inspection and maintenance. The overhead location of the camshaft greatly enhances accessibility to the crankcase. Fuel pumps, governor and control shaft are readily accessible from the engine platform.

The mechanical injection equipment on this engine was developed by Bosch from designs evolved in collaboration with Nordberg engineers. The fuel pumps are reported to be the largest of their type ever made in this country and special consideration was given to physical dimensions as well as to mechanical details.

The engine is also designed for the application of the Nordberg system of gas injection which results in burning natural or manufactured gas with the thermal efficiency of the Diesel cycle. The usual provisions may also be made for converting the engine to run on fuel oil.

This engine was completely erected in the company's shop and given the following tests:

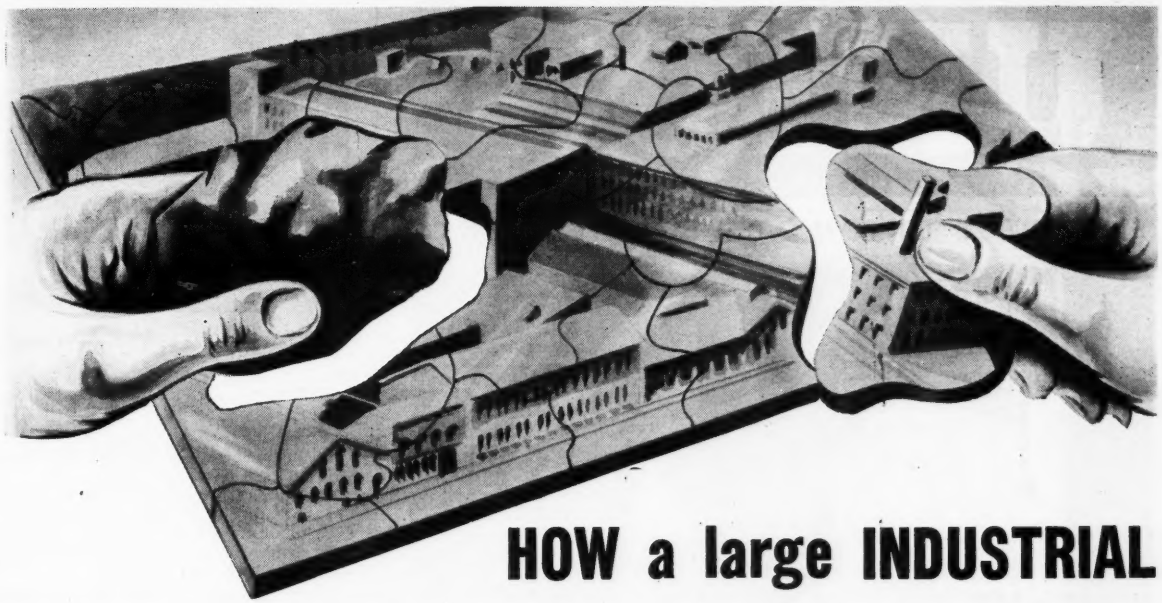
(a) 360 hr continuous endurance run with the engine developing normal shp of 6000 at 160 rpm
(b) 48 hr continuous run at 110 per cent load or 6450 shp at 165 rpm
(c) 2 hr at 125 per cent load (7300 shp at 172 rpm)

Other tests were run to determine starting, governing and maneuvering characteristics, and fuel consumption at various loads with corresponding propeller rpm. All tests were conducted with the engine burning heavy fuel oil and the fuel consumption results are shown on the attached curve. The fuel consumption as shown does not include the power to drive the scavenging air blower. This power will be obtained from the auxiliary generating sets aboard the vessel. The input to the blower at normal load is 430 bhp.

Fuel Oil

Higher powered Diesel engines for propelling cargo ships, tankers, combination cargo-passenger and other vessels must be capable of operating on low grade fuel oils.

The engine tested is of the mechanical injection type with water-cooled fuel nozzles. The fuel consumed during the continuous 17-day test at 100 per cent, 110 per cent and 125 per cent loads varied from 1000 to 1200 SSU at 100 F, 11.5 to 12.5 Baume at 60 F, and contained from 11.4 to 17 per cent hard



HOW a large INDUSTRIAL PLANT solved its fuel problems 10 years ago.

COAL BUREAU HELP IS TIMELY, INSURANCE

Long, successful experience is behind COAL BUREAU service—in assisting in the preparation of your coal specifications to insure an available supply—in helping you realize the maximum performance of the coal you use—in cooperating with you and your consulting engineer in modernizing your plant to utilize your coal most efficiently and economically. We've helped others and we can help you.

FAIRMONT COAL . . . IN HUGE RESERVES . . . is *almost in your own back yard* . . .

Let us tell you all about the coal that's mined within easy transportation distance and how it will solve the fuel problem for the life of your plant.

When a large Eastern industrial plant entered on a program of modernization back in 1934-36, careful consideration was given to both coal and equipment. The engineers of this plant wisely drew up design specifications for fuel burning equipment which would give satisfactory performance and maximum economy with a wide range of coals. Result—this plant has effected large annual savings in steam cost through the use of low fusion Fairmont Coal. You have just as great an opportunity to save fuel dollars in the future through the use of Fairmont Coal, the huge reserves of which will be available for many years to come. Coal Bureau engineers are ready to show you how you can plan your fuel supply and your plant for low cost steam generation on a long range basis.

COAL BUREAU—UPPER MONONGAHELA VALLEY ASSN.
CHANIN BLDG., 122 E. 42nd ST., NEW YORK CITY

MAIL COUPON TODAY

COAL BUREAU—Upper Monongahela Valley Assn.
Chanin Bldg., 122 E. 42nd St., New York City

Kindly place me on your mailing list to receive copies of "Coal Reference-Bulletins." It is understood these will be sent me FREE and without obligation.

Name .....

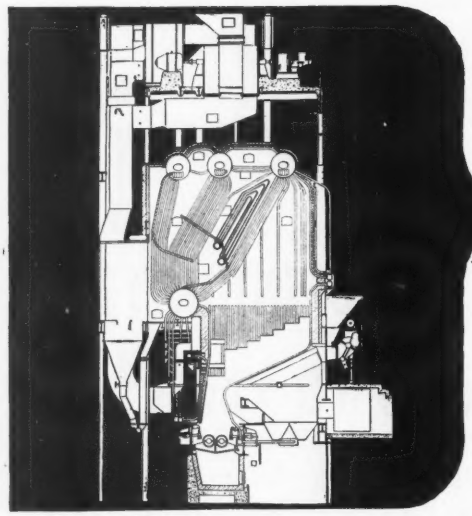
Company .....

Position .....

Address .....

UNION

FILE THESE UNION ADS FOR REFERENCE



H-TYPE
A-TYPE
4-DRUM
RADIANT TYPE
L-TYPE
O-TYPE
LONG DRUM
CROSS-DRUM
UNIVERSAL STEEL-CASED
UNIVERSAL BRICK-SETTING
HORIZONTAL RETURN TUBE
LITTLE GIANT
HEATING

4-DRUM TYPE

UNION BOILER DESIGNERS have a broad background of experience and a large, well-equipped plant to provide the flexibility necessary to build the right boiler for the job. The Union 4-Drum type shown above has many features that skilled boiler men will catch at once.

We are not hidebound at Union. We get a kick out of making the smallest boiler as efficient as possible and have tackled some of the largest boiler jobs issued by Uncle Sam without the slightest hesitation. We'll let the results tell the story. One of the thirteen basic Union designs will meet your steam problem. *Let's have a look at it.*

UNION IRON WORKS ★ ERIE, PA ★

BOILERS

PRESSURE VESSELS • PLATE FABRICATION

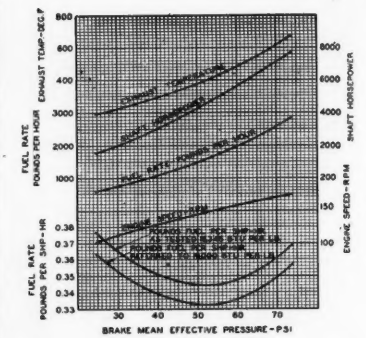


Fig. 3. Test results of 6000 hp marine Diesel engine

asphalt and 9 to 10 per cent Conradson residue.

Prior to the beginning of official tests, heavier fuel oils of 1400 to 1600 SSU at 100 F were consumed over long periods of time with clear exhaust and with no difficulty. No changes were made in the fuel injection equipment and there was no noticeable change in fuel consumption.

Many samples of the fuel oils used during the official test showed the following average analysis after being centrifuged:

SSU at 100 F	1076
Baume at 60 F	11.5
Flash point, F	261
Fire point, F	324
Sulphur	.82
Water and sediment, %	.59
Asphalt, hard, %	13.2
Conradson residue, %	9.57
Btu's/lb, hhv	18,345

It is conceded that the lower grades of fuel oil can best be burned in slow-speed, two-cycle, heavy-duty Diesel engines. Proper timing of fuel admission is necessary and the timing may easily be varied within the limits required for a wide range of fuels. The results of exhaustive tests of this engine indicate that it will successfully operate on heavy, low-grade fuel oil.

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

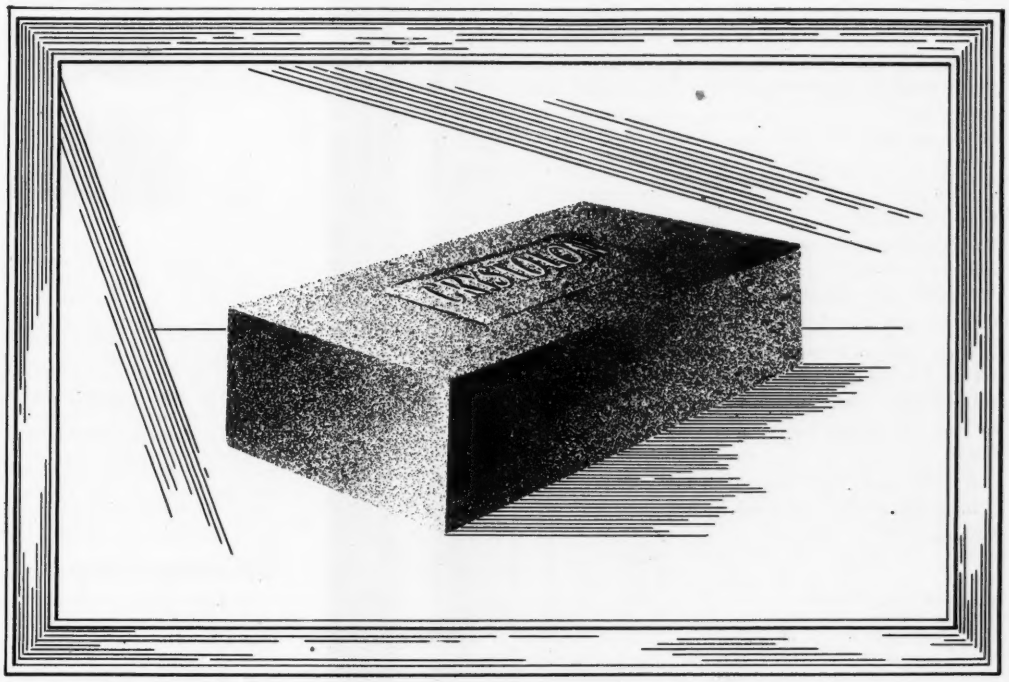
Water Level Control

DEVISED TO CONTROL positively and accurately both the water level and the firing of boilers of all types, the Faratron Boiler Water Control is a new product developed by the Lumenite Electronic Co., 407 S. Dearborn St., Chicago 5, Ill.

In operation, this control makes use of three electrodes of different lengths, mounted in a special fitting, directly connected to the boiler. These electrodes are connected, by a special cable, with the Faratron electronic unit, which can be placed anywhere desired, within 200 ft of the boiler.

When the water in the boiler drops below the end of the medium length or low level electrode, the intake valves

Portrait of a Product that didn't win the war



We cannot claim that CRYSTOLON Brick are winning the war. Truthfully, all we can say is that these brick are made to give long service, and our customers report that they are doing so.

CRYSTOLON Brick are densely made of highest grade silicon carbide with a minimum of bond and fired at high temperatures. Their dense surface resists slag penetration. This means that clinkers are easily removed leaving the bricks clean and undamaged. These brick have great strength at elevated temperatures and their resistance to spalling is greater than that of any other commercial refractory material. Because of the extreme hardness of silicon carbide, these brick have remarkable resistance to abrasion.

Along the clinker line of boiler furnaces and at those points where wear and tear are severe CRYSTOLON Brick stand up best. They eliminate wasteful "down time" for lining repairs when peak operation is needed. They reduce maintenance costs at all times.

NORTON COMPANY — Worcester 6, Mass.

Norton Longer Lasting Refractories

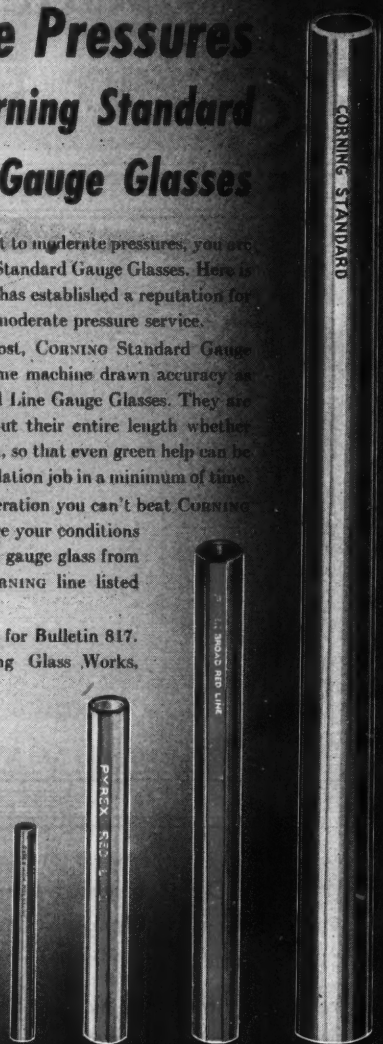
For Moderate Pressures
Use Corning Standard Gauge Glasses

Where gauge glasses are subject to moderate pressures, you are money ahead to use CORNING Standard Gauge Glasses. Here is an economy Gauge Glass that has established a reputation for long life and serviceability in moderate pressure service.

Although lower in initial cost, CORNING Standard Gauge Glasses are made with the same machine drawn accuracy as PYREX High Pressure and Red Line Gauge Glasses. They are of uniform accuracy throughout their entire length whether 10" or 180". Each one fits right, so that even green help can be depended on to do a good installation job in a minimum of time.

For average low pressure operation you can't beat CORNING Standard Gauge Glasses. Where your conditions are "different," select the right gauge glass from the complete PYREX and CORNING line listed below.

Want full particulars? Write for Bulletin 817. Industrial Division, Corning Glass Works, Corning, N. Y.



PYREX brand High Pressure—resistant to thermal and mechanical shock and attack of steam and hot water. Machine drawn accuracy.

PYREX brand Red Line—Same but with added visibility afforded by enameled red line.

PYREX brand Broad Red Line—Same but with fused-in broad red line for extra visibility.

CORNING Standard—For moderate pressures. Long-lasting. Machine drawn accuracy.

"Pyrex" and "Corning" are registered trade-marks and indicate manufacture by Corning Glass Works.

CORNING Glass Works Corning, New York

Corning Gauge Glasses

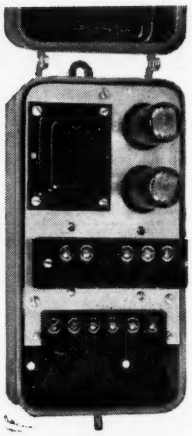
In Cooperation With

THE POST OFFICE

. . . we will appreciate it if you will add our new zone number (4) to all mail addressed to us, as shown below:

POWER PLANT ENGINEERING
53 W. Jackson Blvd. Chicago 4, Illinois

As you know, the new Post Office zone delivery system has been adopted to expedite the delivery of mail. Simple in operation, its success depends on the cooperation of all mailers.

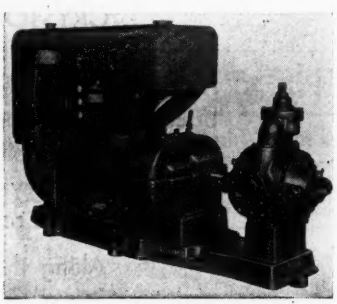


are automatically opened or the feedwater pumps are started. The water continues to flow in until it contacts the short or high-level electrode when valves are closed or the pumps stopped.

If, however, through failure of the water supply or any other reason, the water is not supplied when it drops below the medium electrode and continues to fall until it leaves the end of the long or emergency electrode, the fire is extinguished by cutting off the electric pump or by closing the fuel valve. At the same time an alarm, either a bell, siren or light is activated.

Oil Sludge Pump

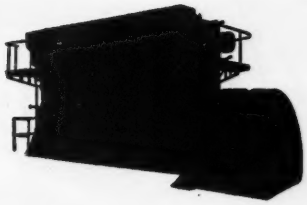
A NEW 300 gpm pumping unit, powered by a 25 hp Diesel engine has recently been produced by the Blackmer Pump Co., Grand Rapids, Mich. The new pump is designed for handling oil sludge and is fitted with steam jacketed heads to lower the viscosity of the pumpage. The engine speed is 1200 rpm, reducing through a double-reduction, oil-immersed drive to 300 rpm on the pump shaft. The discharge pressure of the pump is 25 psi.



Currently these pumping units are being furnished to the U. S. Navy. Similar units, powered by Diesel, conventional gasoline or steam engines, or electric motor have many industrial applications and will be a part of the Blackmer post-war line.

Unit Heater

HEATING SMALL STRUCTURES and providing additional heat for limited areas is the function of a small model of the Dravo Direct Fired Heaters which has recently been developed with capacities ranging from 300,000 to 850,000 Btu per hr.



Your order now will make for

POST-WAR ORDER IN INDUSTRY

Like any other good American organization, Busch-Sulzer stood by for orders from Washington after December 7, 1941. Since then, we have been working 'round the clock on Diesel engines or war materials for the Army, Navy and Maritime Commission and on engines for high priority. We intend, of course, to continue doing so until Washington says that the "end of the beginning" has turned definitely into the beginning of the end.

When peace comes, it is vital that America keep as many of its workmen busy as is possible. Some industries cannot escape labor layoffs during the period of re-tooling. Not so the Diesel industry if . . .

The "if" means if it has work to do. The work should be there if the plans are well-ordered, because there is a great need for Diesels because of obsolescence, because of interrupted enterprises and enterprises planned. Little can be expected from Europe, some of whose Diesel plants have been bombed out of existence or badly damaged.

Busch-Sulzer has expanded its facilities greatly since 1941 and has increased its carefully trained personnel by 50 percent in the last 20 months. We are anxious to keep these men and machines busy and help to achieve the peacetime stability that all of us yearn for.

Please send us your inquiry now so that your requirements can be met without further loss of valuable time when capacity becomes available.

BUSCH-SULZER BROS.-DIESEL ENGINE COMPANY

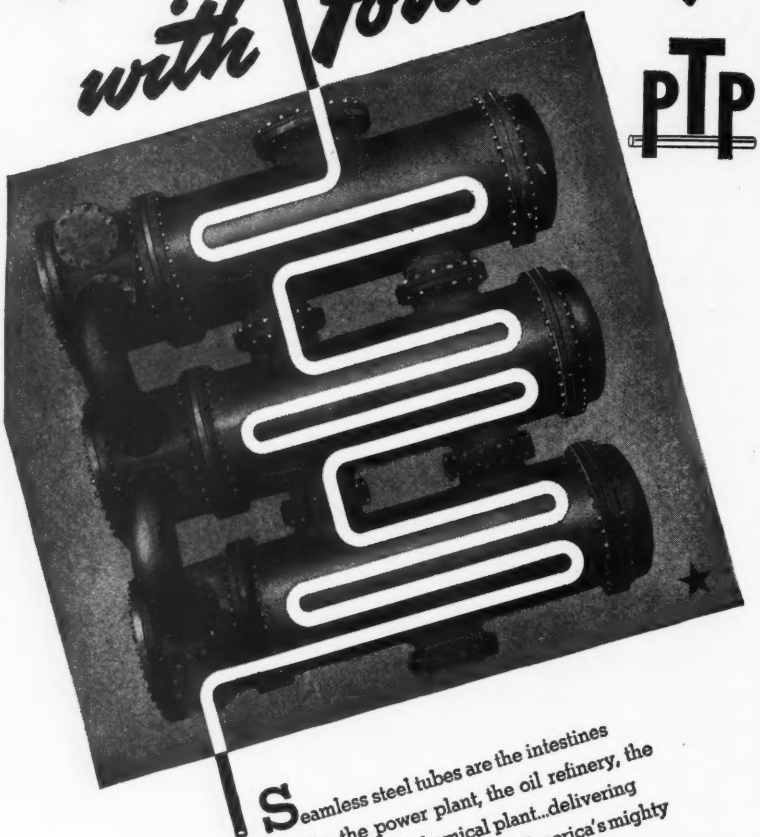
SAINT LOUIS

AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

BUSCH-SULZER
ST. LOUIS

INTESTINES with Fortitude!

PTP

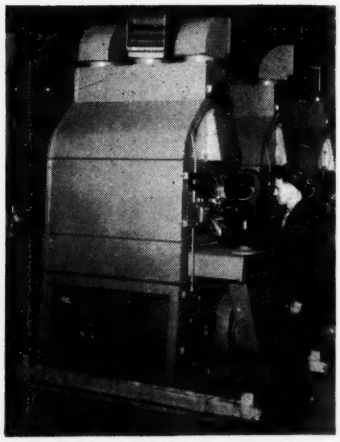


Seamless steel tubes are the intestines of the ship, the power plant, the oil refinery, the locomotive, and the chemical plant...delivering an ever-flowing flood of power to America's mighty production efforts.

Seamless steel tube "know-how" is vitally necessary to keep those lines going steadily. Cold drawn seamless steel PTP tubing achieves accuracy to size and uniformity of gauge through exacting control and thorough inspection at every step in manufacture. Where cost is a factor, and seamless steel tubing required, PTP tubing offers an economical and satisfactory solution to the problem.

★ Heat Exchangers. Photograph courtesy of the Whitlock Manufacturing Company, manufacturers of heat transfer equipment.

PIPE & TUBE PRODUCTS
INCORPORATED
Manufacturers of Cold Drawn Seamless Steel Tubing
JERSEY CITY, N. J. • WORKS: READING, PA.



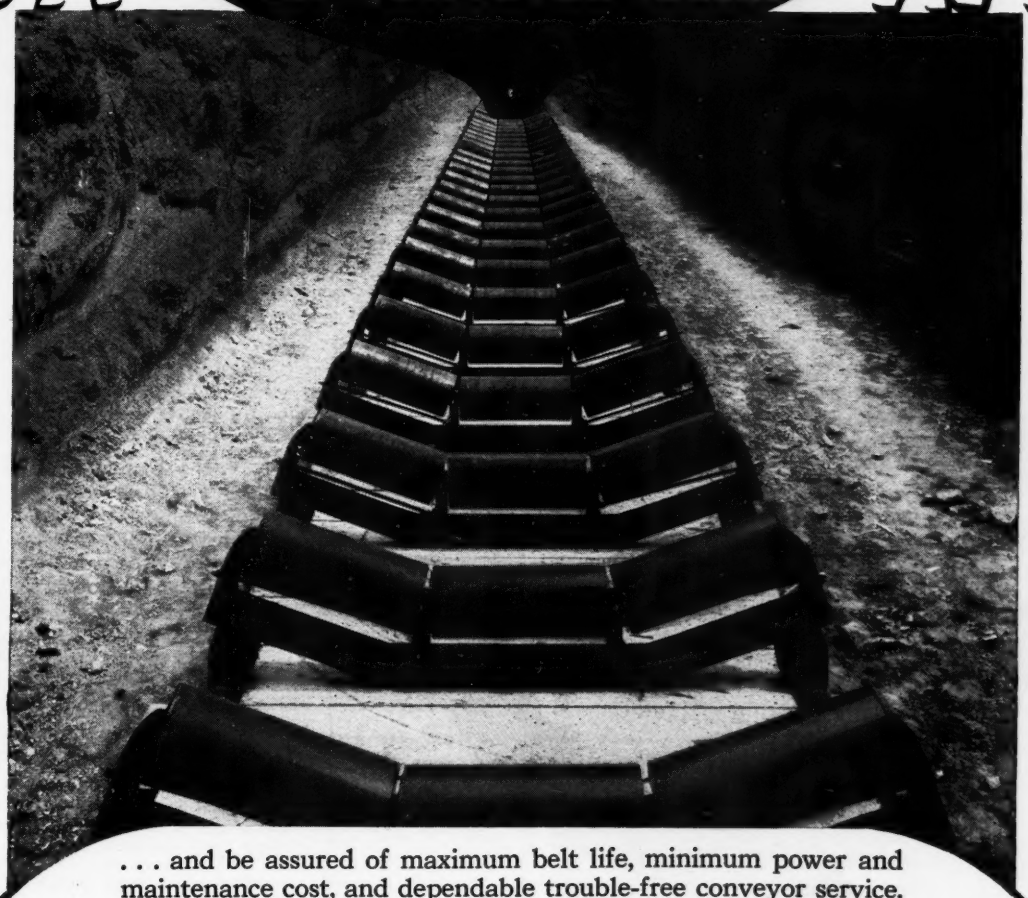
This new model, the product of Dravo Corp., 300 Penn Avenue, Pittsburgh, Pa., retains the principal characteristics of the corporation's regular line of direct fired heaters but on a scale in keeping with the smaller Btu output. Overall size has been reduced in proportion so that floor space requirements are now just 5¼ by 3 ft. It can also be suspended from the wall where floor space is not available. This model can be equipped to burn either gas or oil. Oil burners may be quickly removed and gas burners and controls substituted or, vice versa, as conditions direct. The heater is thermostatically controlled and requires a minimum of manual attention. A small unit of this size is an excellent complement to present heating systems to provide warm air in remote parts of buildings not reached by the present system.

Voltage Tester

ANNOUNCEMENT is made of a hand size electrical instrument that tests without lamps, gives positive voltage identification and distinguishes between a-c and d-c, by Square D Co., 6060 Rivard St., Detroit 11, Mich.

A-c voltage markings are 110, 220, 440 and 550. D-c markings are 125, 250 and 600. Frequencies can be determined by the vibrations of the indicator. The device is housed in a cylindrical fiber case, for easy gripping. The 4 in. fiber grips on the leads give complete insulation and leads are 24 in. flexible wire, with double thickness, rubber insulation vulcanized to the wire to prevent slipping. A peg and spring assembly prevent sharp bending and breaking of leads where they enter the case. Sharp spear points on the ends of the leads permit piercing of wire insulation for testing without damaging it.

LAY THAT "BELT" DOWN ON
LINK-BELT
ANTI-FRICTION
BELT CONVEYOR IDLERS



. . . and be assured of maximum belt life, minimum power and maintenance cost, and dependable trouble-free conveyor service. Link-Belt engineers pioneered in the development of anti-friction belt conveyor idlers and have consistently improved the original, fundamental design—the grease seal, bearing adjustment, shaft mounting and the supporting stands and brackets. All with the result that today's Link-Belt designs offer the very best in belt conveyor equipment.

9451

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Toronto 8.
Offices, factory branch stores, and distributors in principal cities.

LINK-BELT

LINK-BELT THE SYMBOL OF QUALITY LINK-BELT COMPANY

BELT CONVEYOR EQUIPMENT

IDLERS • TRIPPERS • BELTS • PULLEYS • BEARINGS • DRIVES

Gasoline Hammer

THE SYNTRON CO., 494 Lexington, Homer City, Pa., announces a new style completely self-contained, gasoline hammer paving breaker type of demolition tool.

This hammer is comparable in power to the larger-sized compressed air paving breakers—weighs 96 lb—is arranged for easy operation by one man—and uses a full complement of points.

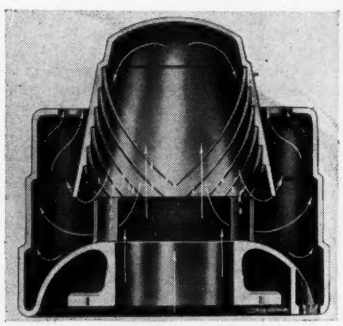
Throttle control of the blow permits placing the tool on the spot desired to be worked, without jumping around. The hammer can drill rock to a depth of 30 in. The major advantage of this tool is that it is completely self-contained.

In principle, it consists of a two-cycle gasoline engine in an inverted position, with two pistons, one an engine piston and one a hammer piston. The engine piston is connected to the crankshaft at the top of the hammer and drives the flywheel ignition magneto, and a fan for forced air cooling. Starting is by a rope pull, the same as any outboard engine.

The free hammer piston acts as a movable cylinder head for the engine piston, and as the explosion occurs, is driven downward to strike directly on the shank of the tool being used, and then is returned to the "up" or firing position, not by springs, but by low pressure exhaust gases. Fuel (gasoline mixed with oil) consumption is relatively low—the hammer being equipped with a fuel tank having a capacity sufficient for several hours operation.

Exhaust Head

TWO SPECIAL ADVANTAGES are claimed for a new free flow exhaust head, embodying the Wright-Austin principles for the complete separation of oil and water from exhaust steam. First, by removing all moisture before steam is blown out, it wholly eliminates the water spray which is one of the principal causes of rust or erosion of roofs, smokestacks or other parts of buildings. Second, it eliminates the objectionable noise ordinarily associated with exhaust head operation.



As will be seen from the illustration, directional vanes or ribs are cast on the inside of the head, to collect and carry the separated moisture and oil out of the steam flow. For complete elimination of these contaminants, the normal steam velocity is slowed down by a two-stage expansion of the steam—first in the dome, and again in the body surrounding the dome.

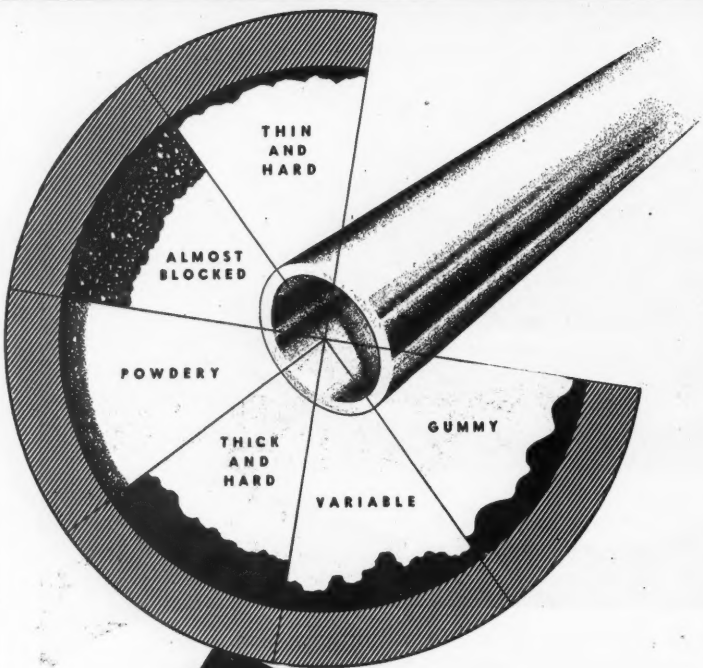
A further important feature is an outlet opening much larger than the area of the intake pipe, permitting the exhaust to escape easily, without back pressure. This feature is said to assure practically silent operation.

The new exhaust head (type FF) is made for all pipe sizes from 1½ in. to 14 in., standard or special, to meet individual conditions. Wright-Austin Co., 331 West Woodbridge St., Detroit 26, Mich., is the manufacturer.

Propeller Type Flow Meter

BUILDERS-PROVIDENCE, INC., 9 Codding St., Providence, R. I., has just announced a new propeller type flow meter for main line metering. This unit, called a Propeloflo Meter, has an 8-blade bakelite propeller moulded in one piece. Rotation is transmitted

WILSON TUBE CLEANERS



for every kind of deposit wilson

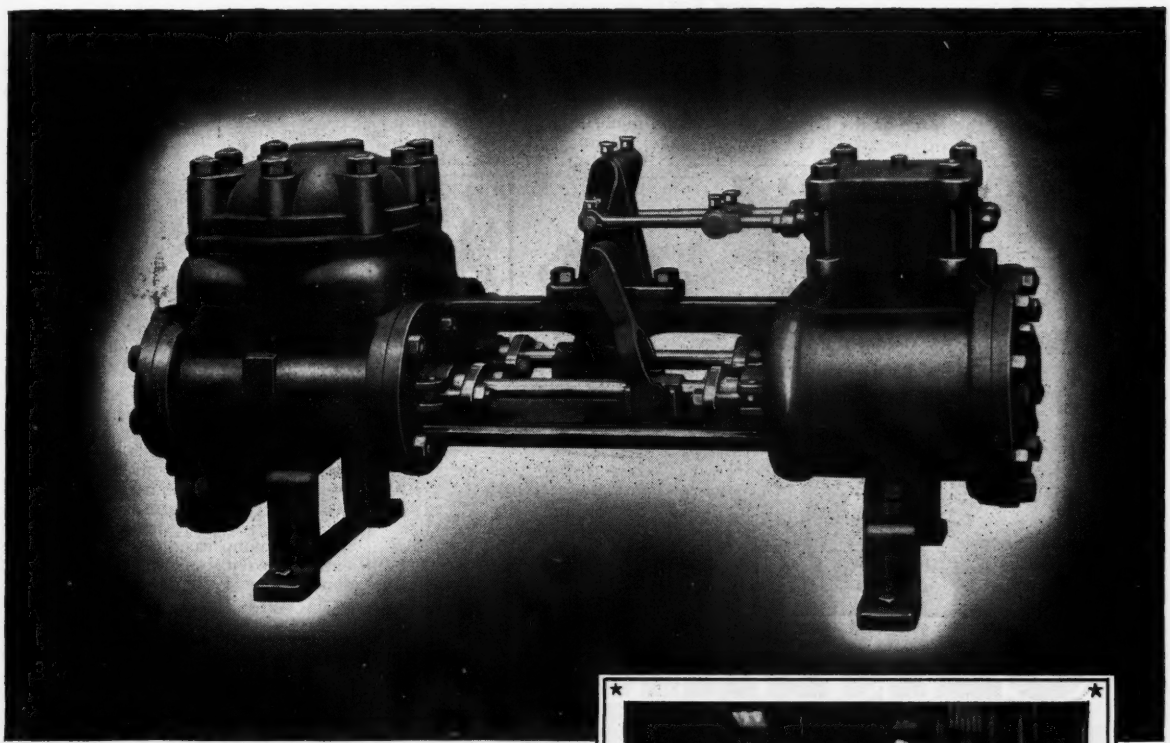
PIPE AND TUBE CLEANERS EXCLUSIVELY

Modern tube-cleaners for the problems of today.

THOMAS C. WILSON Inc.

21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

A Pump With A Future That's Beginning Right NOW...



. . . Check The Features of This WARREN REALWEAR Horizontal Duplex Piston Pump

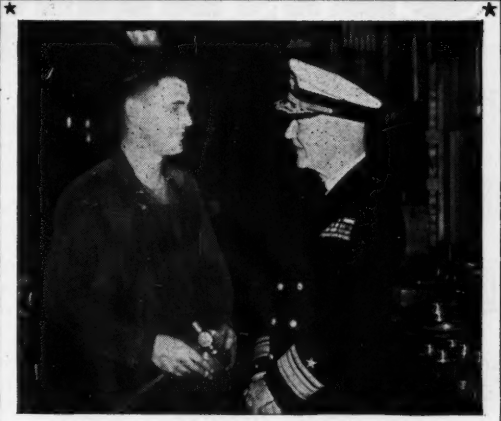
Here's good news for Industry . . . and Post-war Planners! The Realwear Type of Warren Pumps are becoming available in standard sizes again in limited quantities for commercial uses.

Warren Realwear Horizontal Duplex Piston Pumps have made unusual endurance records, low maintenance records and operating efficiency records. Like all Warren Pumps they are "built to fit the job" . . . with no compromising with sound engineering and construction features. And as an added PLUS value, extra wear and corrosion resistance is **standard** with these Warren Realwear Pumps.

Check over the following features of these pumps.

- One-piece type stainless steel piston rods
- Engine-type stuffing boxes, with glands held by swing bolts
- Renewable bronze bushings for valve gear links
- Multi-disc type pump valves of stainless steel
- Valve stems protected against wear by renewable bronze sleeves
- Centrifugally cast bronze cylinder liners

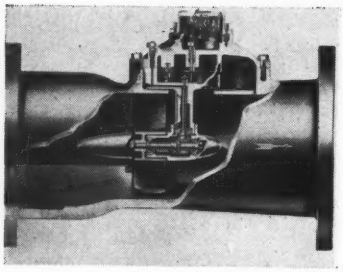
Investigate the Warren Realwear Pumps for **your** plant. Send for more information . . or write for bulletin or Warren catalog.



WHEN OUR COUNTRY WAS ATTACKED our Navy . . Army . . . Merchant Marine and War Industries needed more and more Warren Pumps — and Warren has been "all-out" ever since. It is the pride that our skilled workers take in Warren Pumps that enable Warren Equipment to perform so faithfully under the do-or-die conditions of war production and battle. And it is this pride that enabled Warren Workers to win the Army-Navy "E" Award — at the presentation of which this picture was taken.

ARMY E NAVY

WARREN STEAM PUMP CO., INC.
WARREN, MASSACHUSETTS

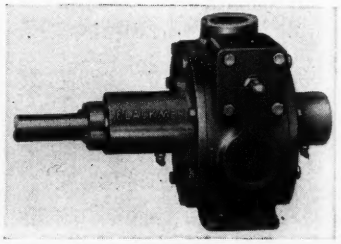


through spur and bevel gears. Shafts rotating in ball bearings assure maximum power to drive indicating and recording devices or proportioning chemical feeders. A Venturi throat evenly distributes the force of the flow against the full area of the propeller, resulting in accuracy throughout an exceptionally wide range of flow. Spiral flow is eliminated by straightening vanes just upstream of the propeller.

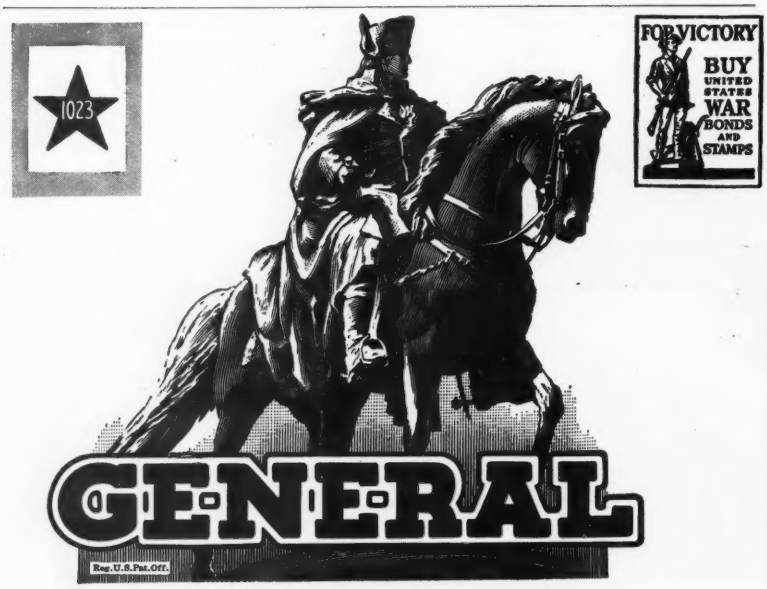
The propeller hub, bracket and nose are streamlined to reduce flow disturbance and divert fine grit, sand or scale away from the mechanism. Servicing is made easy by the provision of a "one-shot" lubrication system, a readily accessible stuffing box, and an easily removed propeller mechanism. Wherever debris or heavy foreign material may be carried along the line with the moving fluid, Builders recommends and can furnish a section of pipe having a coarse screen and hand hole, to be inserted upstream from the meter. Builders Propeloflo Meter, Model PRF, is a precision-made instrument providing wide range, accuracy and low pressure loss in the measurement of liquid flow in lines 6 in. and larger.

Truck Pump

DETAILS of a new truck-mounted pumping unit have been released by the Blackmer Pump Co., Grand Rapids, Mich. While the new pump differs materially in appearance and in certain details of design, from the present model, the bucket design, swinging vane principle of operation that characterizes all Blackmer pumps, is used. The outstanding construction feature appears to be the double bearing arrangement, one on each side of the rotor. This placement of bearings should virtually eliminate shaft whip and distortion.



Being compact and light in weight, this new pump is suitable for mounting on small trucks. It is designed for standard power-take-off drive and has a capacity of 35 gpm at 525 rpm. Normal operating pressure is 45 psi. A relief valve of Blackmer design, built into the pump casing, will by-pass the entire capacity of the pump without shock or end-thrust on the working parts, and is free from "chatter." Suction and discharge connections are tapped for 1½-in. iron pipe. Provision can be made for mounting a standard strainer at the suction of the pump or at a convenient point in the suction line, remote from the pump.



RODA — High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER — A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE — Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER — Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal — Genuine New River Smokeless, Beckley or Sewell seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky — Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

GENCO — Steam and domestic coals from a number of producing districts.

ANTHRACITE—Hazle Brook Premium . . . Raven Run

Our personnel with the experience gained through long and varied marketing activity assures proper application of one of the above brands and effective servicing of any fuel requirement.

GENERAL COAL COMPANY

123 SOUTH BROAD STREET — PHILADELPHIA, PA.

BRANCHES:

BLUEFIELD, W. VA. — BOSTON — BUFFALO — CHARLESTON — CHARLOTTE, N. C.
CINCINNATI — DETROIT — NEW YORK — NORFOLK — PITTSBURGH

OBITUARIES

W. E. Becker

WALTER EUGENE BECKER, widely known southern regional manager of the York Corp., died unexpectedly in Houston, Texas, April 10, at the age of 57.

Born in Chicago, he attended primary school in that city, later attended St. John's Military Academy, Delafield, Wis., and still later the University of Wisconsin in Madison.

Mr. Becker's first business connection, made when he was 19, was as secretary of the Pilsbry-Becker Engineering Co., a distributor of York Manufacturing Co., then being organized in St. Louis. This firm was engaged in engineering and constructing ice plants and cold storage facilities from St. Louis to Salt Lake City and from Jackson, Miss., to El Paso, Texas. The Becker part of the firm was Mr. Becker's brother, Victor, who died in 1932.

In 1911 Walter Becker accepted the position of treasurer and manager of York Engineering and Supply Co. of Houston, and in 1918 he went to France as a civilian with the First Ice Plant Co., a group of engineering and con-

SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES

In the MODEL Power Plant OF UNITED STATES TOBACCO CO.

Extra Quality MODEL SMOKING TOBACCO For Pipe or Cigarette

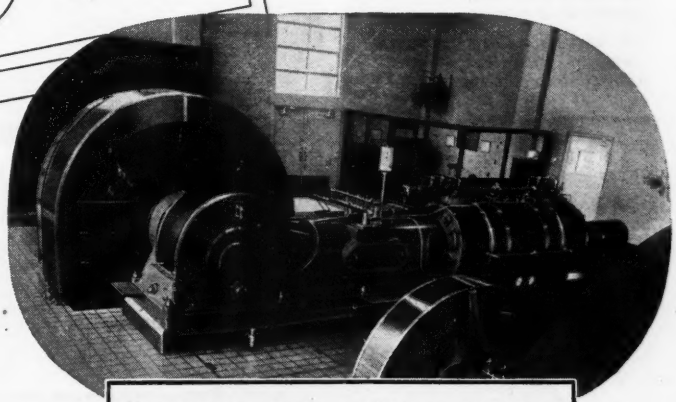
IT took efficiency (and that's a mild word for it) to pack all the satisfaction that's found in MODEL tobacco into a ten-cent package. It took efficiency in sales promotion to build that package into a position of national leadership.

The same kind of efficiency, from roof to cellar, went into the planning of the handsome, modernistic MODEL factory at Richmond, Virginia. All of the power equipment for this plant was selected after considering the most economical operation on the basis of heat, light and power costs, with the maximum use of exhaust steam for process.

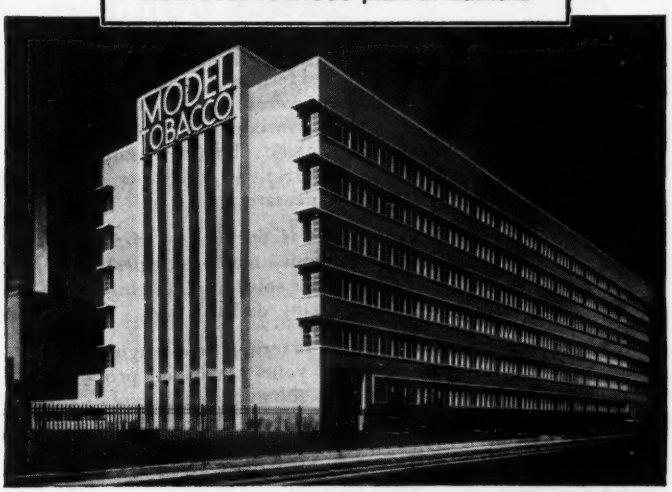
The outstanding performance of a Skinner "Universal Unaflow" engine-generator unit in the Chicago plant of the United States Tobacco Co., and the selection of two of these engines for its new factory at Nashville, Tennessee, made "Universal Unaflow" engines the logical choice for Richmond.

The high economy of the "Universal Unaflow" engine is permanent—maintained throughout the life of the engine by the use of steam-tight poppet valves, an exclusive Skinner feature.

More than 2,000 power users, in industries and institutions of various types, have found it more economical to generate their electric power with Skinner "Universal Unaflow" Steam Engines.



One of the two horizontal "Universal Unaflow" engines driving 500 kv.a. generators in the MODEL TOBACCO plant at Richmond



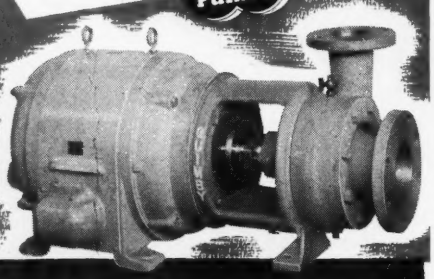
SCHMIDT, GARDEN & ERIKSON, ARCHITECTS, CHICAGO

ARMY E NAVY

Let's All Back The Attack—Buy More War Bonds

For Over 75 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

Announcing
QUIMPACT
the New Quimby Close-Coupled Centrifugal Pump
QUIMBY PUMPS
● Compact, rugged, efficient, low cost.
● Hydraulically and mechanically balanced.
● Double volute construction on larger sizes to eliminate shaft deflection.
● Adjustable foot under pump frame supports pipe loads.
● Sealed shaft sleeve protects entire shaft extension.
● Sizes 1 in. to 6 in. for capacities to 1000 GPM, heads to 150 ft., temperatures to 300°F.

QUIMBY PUMP COMPANY
INCORPORATED
Division of H. K. Porter Company, Inc.
Pittsburgh, Pa. • Blairsville, Pa.
Newark, N. J. • New Brunswick, N. J. • Mt. Vernon, Ill.

CORROSION
Causes Expensive Replacements
Here is a cross section of a severely corroded water cooled connecting rod of a large gas engine. This corrosion can be controlled with our Chrom Glucosates.
This is but one of the many subaqueous corrosion problems that are solved by Haering and Company daily.
Let a Haering field engineer survey your corrosion problems and submit recommendations without any obligation on your part.
Write for "Scale and Corrosion Control in Aqueous Systems."
We Read Water
D. W. HAERING & CO., Inc.
GENERAL OFFICES:
205 West Wacker Drive, Chicago 6, Illinois

struction experts under the leadership of Luther Bond, Sr. In 1919 he joined the Lane and Bowler Co., Memphis, Tenn., manufacturers of deep-well pumps and related equipment.

Since 1922, Mr. Becker had been with the Houston branch of the York Ice Machinery Corp., being made manager of the Houston branch in 1927. In 1931 he was made southern regional manager, which brought Atlanta as well as Houston under his supervision.

E. D. Dickinson

E. D. Dickinson, who at the time of his retirement last May was Designing Engineer of the Turbine Engineering Division of General Electric's Lynn River Works, died on April 28 at the age of 66. He was in the Company's employ for 43 years. At the time of his retirement, Mr. Dickinson was the oldest turbine engineer in the General Electric Co., both in age and service, and had a longer service record in turbine engineering than any other engineer in active service in the world.

Born in Barrie, Ontario, Canada, Mr. Dickinson studied mechanical and electrical engineering at University of Toronto; was first employed as draftsman by G. E. in 1900, and during 1901 and 1902 took the "test" course. He was assigned to the Turbine Engineering Department in 1907. Early in the century he was sent to Chicago to put into operation the first 5000-kw turbine which was installed at the Commonwealth Edison Co.

In 1908, Mr. Dickinson went to Paris in the interest of the Compagnie Francaise Thomson-Houston. He returned to Schenectady in 1912 and served in the Central Station Engineering Department and Marine Engineering Department. During the first World War, he was in charge of the Ship Propulsion Division of the Turbine Department in Schenectady and in 1922 Mr. Dickinson was transferred to Lynn as designing engineer of the Turbine Engineering Division there.

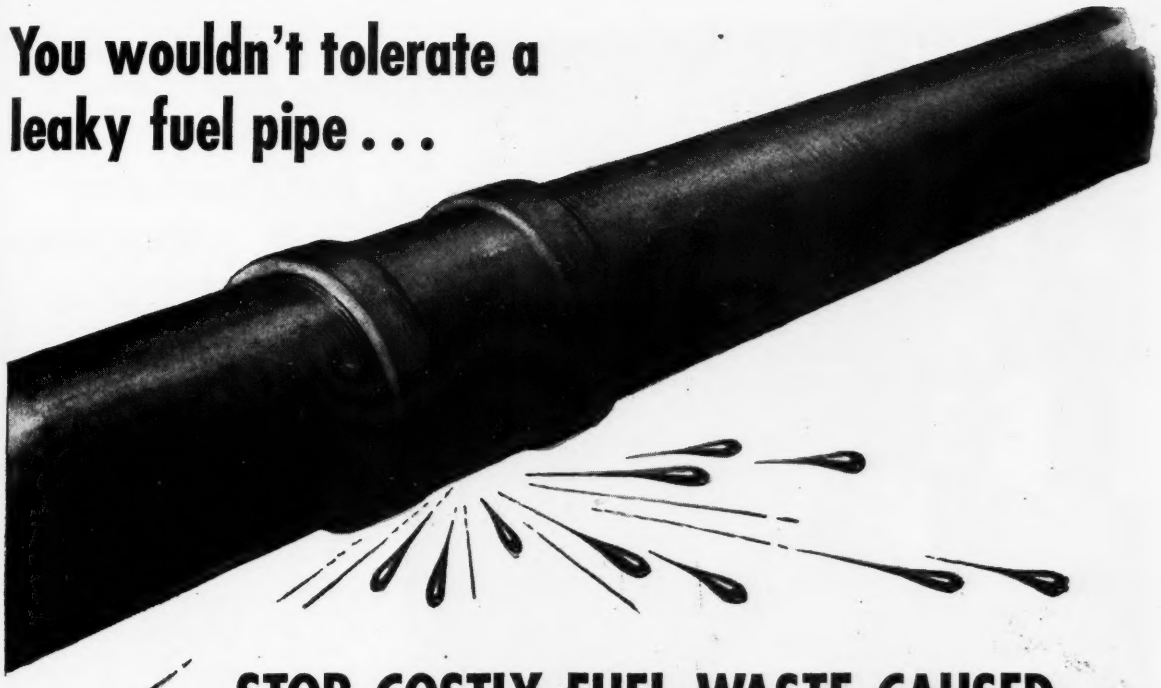
During the present war, and prior to his retirement, Mr. Dickinson had directed the design of turbines for propelling many types of ships for the Maritime Commission and the U. S. Navy, notably cargo ships, tankers, and destroyer escort vessels.

Michael M. Klosson

Michael M. Klosson, Chief Engineer of Buffalo Pumps, Inc., and one of the country's leading hydraulic engineers, died suddenly on April 11th, while on a trip to the West Coast. Mr. Klosson was 51 years old. He joined Buffalo Pumps, Inc., in 1920 and became Chief Engineer in 1929. He was a Director of the Company.

He was a member of the American Society of Mechanical Engineers, the Technical Association of Pulp and Paper Industry, the Society of Naval

You wouldn't tolerate a leaky fuel pipe . . .



STOP COSTLY FUEL WASTE CAUSED BY INEFFICIENT COMBUSTION— MODERNIZE YOUR BOILER PLANT

In many plants there's a steady fuel "leak" that goes unnoticed—the waste caused by inefficient combustion. In these days, when every gallon of fuel oil is a matter of national concern, it's a patriotic duty for plant managers to check up on their combustion equipment.

Great advances in fluid fuel burners have been made by TODD engineers. Today TODD burners are producing notable economies in thousands of installations, both stationary and marine. Indeed, when TODD burners replace less efficient types, it is not uncommon for an industrial plant, power house or commercial building to gain fuel savings as high as 10% or more—*with even greater increases* in heat and power production as well.

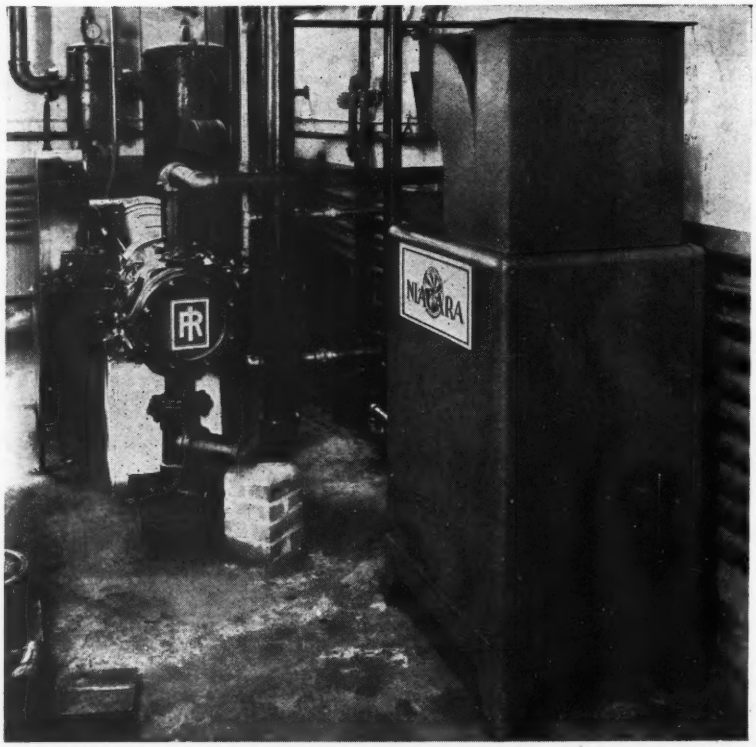
Reducing your cost of producing steam now, by installing more efficient combustion equipment, will improve your plant's post-war competitive position. Steam is a "raw material" in the production of almost every product, and its cost is an important factor in the selling price.

Conditions today are favorable for boiler plant modernization—to cut fuel consumption and increase the production of power. TODD engineers will be glad to make an impartial survey for you.

TODD SHIPYARDS CORPORATION
(COMBUSTION EQUIPMENT DIVISION)
601 West 26th Street, New York 1, N. Y.

NEW YORK ★ BROOKLYN ★ HOBOKEN ★ BARBER, N. J. ★ SO. PORTLAND, ME.
GALVESTON ★ HOUSTON ★ MOBILE ★ NEW ORLEANS ★ LOS ANGELES
SAN FRANCISCO ★ SEATTLE ★ TACOMA ★ BUENOS AIRES ★ LONDON

ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT



Better COMPRESSED AIR After-Cooling

● Keeping moisture out of compressed air is the best way to prevent troubles and damage to pneumatic equipment. Water, condensing in the air lines, wears out and rusts out the vital parts of compressed air tools as well as freezing up air lines and delaying production. In many industrial uses excess moisture or oil in compressed air is also damaging to other materials or products.

The best way to halt such troubles is to use a NIAGARA Aero AFTER COOLER with your air compressor. By evaporative cooling, using atmospheric air as the cooling medium, it obtains lower temperatures and produces compressed air containing only 1/2 to 3/4 as much moisture as air cooled by conventional methods. At the same time it saves cooling water costs, repays its installation cost quickly. It also provides compressor jacket water at controlled temperatures.

For complete information, write to

NIAGARA BLOWER COMPANY

"25 Years of Service in Air Engineering"

NEW YORK Address: Dept. PP-64
6 E. 45th Street,
New York-17, N. Y.

Field Engineering Offices
in Principal Cities

NIAGARA

INDUSTRIAL COOLING • HEATING • DRYING
HUMIDIFYING • AIR ENGINEERING EQUIPMENT

Architects and Marine Engineers and the American Society of Naval Engineers.

Mr. Klosson is survived by his widow, Kenena, and two sons, Boris and Kenneth, both in the Army.

MANUFACTURERS' PERSONALS

R. C. Adams has recently been appointed District Manager of the Chicago territory for the Stoker Division of American Engineering Co., Philadelphia. Mr. Adams is located at 11 South La Salle St., Chicago, Ill.

Dr. J. T. Rettaliata has been appointed manager of the newly created research and gas turbine development division of Allis-Chalmers Mfg. Co. While all Allis-Chalmers steam turbine design and engineering research activities will be conducted by the new division, the role it is to play in development of the gas turbine is perhaps most significant, having built nearly 30 gas turbine units for oil refineries. Their operating data added to experience Allis-Chalmers is getting in production of the aircraft supercharger version of the gas turbine is providing the broadest possible background for development work on this prime mover of the future. Dr. Rettaliata received his degree of doctor of engineering at Johns Hopkins university in 1936. As chief engineer in gas turbine development, J. L. Ray will assist Dr. Rettaliata.

Alexander S. Basil has been appointed assistant factory manager of the Lowell, Mass., plant of the United States Rubber Co. Mr. Basil, a graduate of Rensselaer Polytechnic Institute, started with the company in the wire and cable department at the Bristol, Rhode Island, plant as process engineer on July 19, 1926. During 1929, he became technical superintendent, a position held until 1934 when he was transferred to the general offices in New York City.

McCulloch Engineering Corp., Milwaukee, has appointed Eugene W. Wasielewski as Chief Engineer. Since 1941 Mr. Wasielewski has aided subsidiary companies of Fairchild Engine & Airplane Corp. to develop superchargers as Supercharger Project Engineer for Ranger Aircraft Engines Division and as Executive Engineer of Stratos Corp. He will direct the engineering work at McCulloch in the further development and application of superchargers to Diesel and gasoline engines for land and marine uses.

Harold A. Anderson has been named eastern district manager of The Austin Co., succeeding J. K. Gannett, vice president, whose appointment as the company's director of engineering was recently announced. Originally attached to the eastern district which he joined in 1928 as field engineer and served also as designing engineer and estimator, Mr. Anderson was named district estimator at Chicago in 1939. His headquarters will be at 19 Rector Street, New York City.

W. H. Henson has been appointed refractories field engineer by Norton Co., Worcester, Mass. He will make his headquarters in Worcester and will do engineering work in all of the refractories territories. Eugene A. Fisch-

TROY-ENGBERG STEAM ENGINE

THE *Standard* BY WHICH BY-PRODUCT POWER IS MEASURED

TROY-ENGBERG Steam Engine Power is By-Product Power. The engine is the standard by which by-product power is measured. If you can use all or most of the engine's exhaust steam for heating or processing in the place of live steam, your power immediately becomes exceptionally low-cost power. Many a Troy-Engberg Engine has paid for itself in a year or two. And since it is not at all unusual for these engines to run steadily for fifteen or twenty years without need for major repairs, it is easy to see what an excellent investment they make.

Study your plant and look for two things . . . equipment that needs a drive such as a pump, compressor, stoker, fan or generator; and a place to use the exhaust steam of the engine for heating or processing. Find that combination and it is probable that the Troy-Engberg Engine will produce the cheapest power.

TROY ENGINE & MACHINE CO.

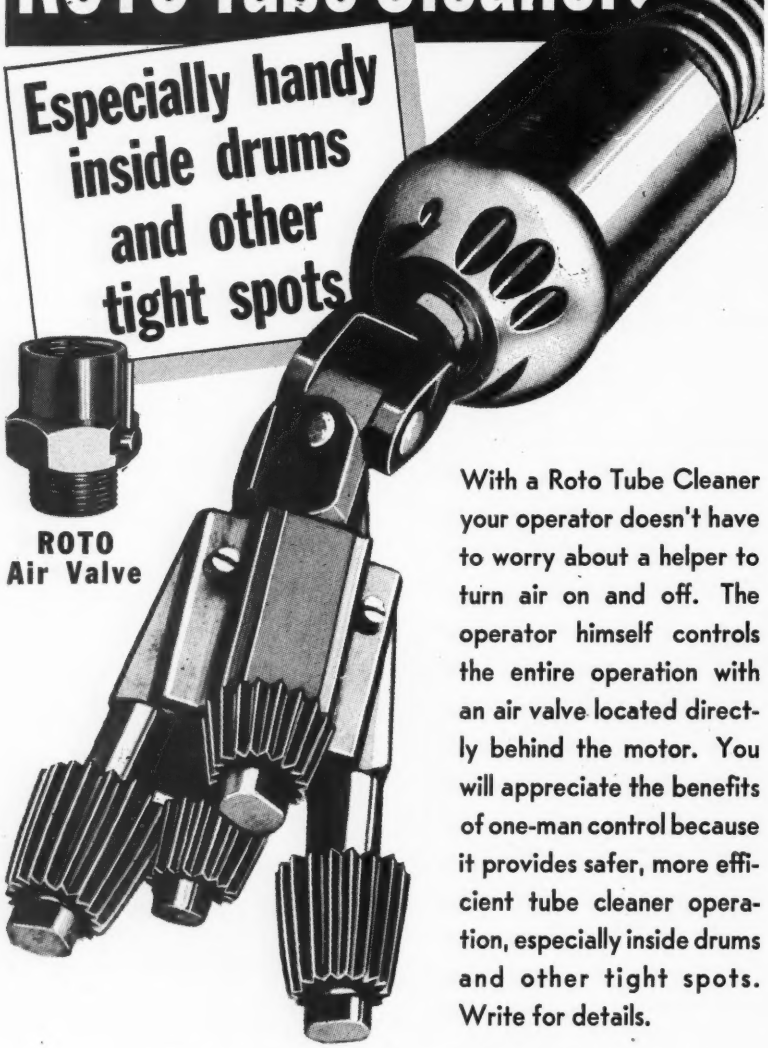
Established 1870

864 Railroad Avenue **Troy, Pennsylvania**

6-TEM-4

ROTO Tube Cleaners

Especially handy inside drums and other tight spots



ROTO Air Valve

With a Roto Tube Cleaner your operator doesn't have to worry about a helper to turn air on and off. The operator himself controls the entire operation with an air valve located directly behind the motor. You will appreciate the benefits of one-man control because it provides safer, more efficient tube cleaner operation, especially inside drums and other tight spots. Write for details.

The Roto Company

145 Sussex Avenue, Newark 1, N. J.

A Division of Elliott Company

WHEN YOU WRITE TO ADVERTISERS

When writing advertisers for catalogs, descriptive bulletins or prices, please remember to say, "I saw your message in POWER PLANT ENGINEERING." Thus you'll do a good turn for the advertiser and for this publication. . . .

er has been appointed New England refractories engineer to succeed Mr. Henson. Mr. Fischer has been connected with the research laboratories and the refractories engineering department at Worcester, where he will continue to make his headquarters.

Ed. Crane has been appointed industrial sales engineer in the Buffalo area for the Brown Instrument Co., Philadelphia precision industrial instrument division of Minneapolis-Honeywell Regulator Co. Mr. Crane has been transferred from the New York City office. He will include the northwest section of New York State in his territory.

H. S. Hubbard has been appointed Assistant Engineer in the Power Transformer Engineering Division at the General Electric Co.'s Pittsfield Works, succeeding A. B. Hendricks, Jr., who has retired after 43 years of service with the company. Mr. Hubbard will be responsible for the design of high-voltage electronic rectifying equipment, high-voltage testing apparatus, precipitation transformers, and resistance and Sciaky welding transformers.

Willard V. Merrihue has been named manager of the advertising and sales promotion divisions of the Apparatus Department of the General Electric Co. Simultaneously he was named a member of the apparatus sales committee of the company. He was previously assistant to the manager of the apparatus publicity divisions, Robert S. Peare, now vice president in charge of the company's advertising, broadcasting and general publicity activities.

Worthington Pump and Machinery Corp. has appointed Walter D. Smith of Tulsa, Okla., as commercial vice president. Mr. Smith is a graduate of Carnegie Institute of Technology and has been connected with the Worthington organization since 1923, except for a period of three years, 1933-36. In his new capacity, Mr. Smith will supervise the corporation's business in the Southwest.

William P. Headden has recently been appointed assistant manager of the Sales Engineering Department of the Standard Oil Co. of New Jersey. Since early in 1943, he has been supervisor of the fuels and lubricants sections of the division.

Ernest G. Brown has been named general manager of mechanical goods, general products and Lastex yarn and rubber thread divisions of United States Rubber Co., succeeding Willard H. Cobb, recently elected vice president and member of the executive committee. Mr. Brown, a graduate of Sheffield Scientific School at Yale University, after years of service as proof officer at the Aberdeen Proving Ground, joined United States Rubber Co. in 1929 in the central planning and engineering department in New Haven, Conn. He was subsequently given important management duties and in 1942 was named head of the shell loading division, when that departmnt was organized.

John W. Barriger, III, has been appointed manager of the newly created Diesel Locomotive Division of Fairbanks, Morse & Co., which will soon be in position to offer railroad companies locomotives equipped with opposed-piston type Diesel engines. Mr. Barriger, since 1927, has been engaged in railway financial, corporate,

HOW'S YOUR VOLTAGE?

You can often iron out difficulties by regulating voltage--and SAVE

New England lab cuts testing time

This laboratory, testing electronic tubes and communications equipment, was getting uncertain test results because of a fluctuating incoming line voltage. It was necessary to repeat some tests over and over to assure accuracy. G-E engineers suggested installing three 3.6-kva, 120-volt automatic induction regulators. These regulators now furnish the exact voltage required for each test, and hold it constant throughout the test. Over-all testing time has been cut in two.

Aircraft plant saves—and speeds inspection

A midwestern manufacturer X-rays all propellors before releasing them for duty, to make sure that they are perfect. Considerable time was being lost because of fluctuations in the voltage applied to the X-ray machine. Underexposure or overexposure of X-ray film was the rule rather than the exception. Numerous "retakes" were necessary. This problem was ironed out with an automatic G-E 2.4-kva, 240-volt, induction regulator. Not only was time saved and production increased but the savings in X-ray film alone paid for the regulator in three months.

Western power company saves critical material

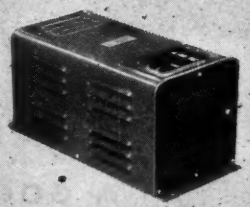
A western radio station experienced trouble because varying loads caused voltage fluctuations on the feeder supplying the station with 240-volt, three-wire, single-phase service. For the power company serving this area to install an *independent* feeder, would have required a large amount of critical material, and would have been difficult because of its effect on the station's elaborate antenna counterpoise. This problem was solved by installing a 2.4-kva G-E induction regulator on the *existing* feeder. Voltage regulation is now reported excellent.

What is your problem?

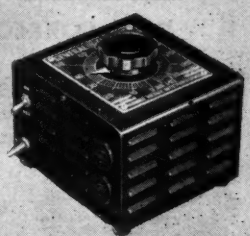
Pepless motors, poor lighting, uncertain test results, and production slumps are often the result of poor voltage. Whether you need voltage control for an electronic tube or a power shovel, there's a simple, economical G-E device for the job. Ask your G-E representative for further information. *General Electric Company, Schenectady 5, N. Y.*

Motor-operated regulator typical of sizes 3.6 kva and smaller. For automatic operation, control panel is furnished separately.

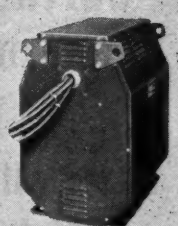
OTHER G-E AIDS TO BETTER VOLTAGE



VOLTAGE STABILIZER—Automatically provides a constant 115-volt supply to a given load, on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes, or built into such equipment as radio transmitters.



VARIABLE-VOLTAGE AUTO-TRANSFORMER—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factories, laboratories, and assembled with other equipment.



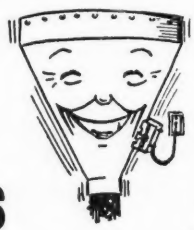
TYPE D TRANSFORMER—For insulating lighting circuits, reducing light flicker, boosting or stepping down voltage for the most economical operation of motors, welding equipment, etc. Ratings up to 100 kva, 600 volts.

THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB **BETTER**

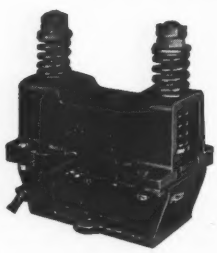
GENERAL ELECTRIC

ARE YOUR
BUNKERS, CHUTES
and
HOPPERS
CONSTIPATED?

A GOOD DOSE
of
SYNTRON
"Pulsating Magnet"



ELECTRIC VIBRATORS
WILL CORRECT THAT CONDITION — QUICK!



3600 powerful vibrations per minute break down arching and plugging. Keep stubborn materials, such as damp, sticky coal free-flowing at all times.

Adjustable power by rheostat control

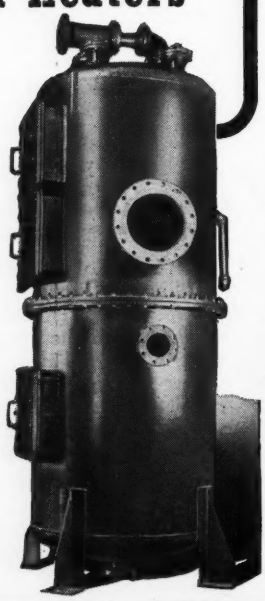
8 different models—ranging from a little 4 lb. model up to a big 500 lb. model for large bunkers.

SYNTRON CO.

494 Lexington Homer City, Pa.

Swartwout Standard Heaters
engineered
to your needs

meet all tests...assure you lifetime trouble-free service



● Swartwout Heaters guarantee the preheating capacity and oxygen removal needed for your boilers—faithfully and economically. They help your plant to deliver full capacity . . . keep maintenance low . . . help save fuel.

Write for Bulletin S-18-D

THE SWARTWOUT COMPANY
18511 Euclid Ave. Cleveland 12, Ohio

Swartwout POWER PLANT EQUIPMENT

and related work. From 1933 through 1941, he was in charge of the railroad division of the Reconstruction Finance Corporation, then became associated with the Carriers' Conference Committee in 1941. He has served in the Office of Defense Transportation, as vice president of the Union Stock Yard & Transit Co. of Chicago, as manager of the Chicago & Eastern Illinois Railroad during its reorganization in 1940, and subsequently became a Director of the Alton Railroad.

Joseph M. Smith has been appointed Technical Director of the Fluorescent Lighting Association and will head up the technical activities of this association composed of manufacturers, contractors, jobbers, engineers, architects and others interested in the standardization and promotion of this latest form of electric illumination. Mr. Smith is responsible for much of the development of cold-cathode fluorescent lamps and fixtures, as well as for some of the outstanding installations.

MANUFACTURERS' NEWS

Maritime Commission "M" Award
General Electric Co.
River Works, Lynn, Mass.
Kennedy Valve Mfg. Co.*
Elmira, N. Y.

National Security Award
Philco Corporation
Philadelphia, Pa.

*Star added for sustained high achievement in production of war equipment.

Purchase of Electric Machinery Manufacturing Co., Minneapolis, Minn., by Worthington Pump and Machinery Corp., Harrison, N. J., has been announced by Harry C. Beaver, president of Worthington, and Walther H. Feldmann, president of Electric Machinery. Electric Machinery's major lines of synchronous motors for direct drive for a wide variety of power plant and industrial machinery, as well as electric generators for steam and internal combustion engines, provide a logical extension of Worthington's already large power and industrial equipment lines. Established in 1897, Electric Machinery has developed a world-wide business in the past 47 years. During much of that time Worthington has been one of its important customers.

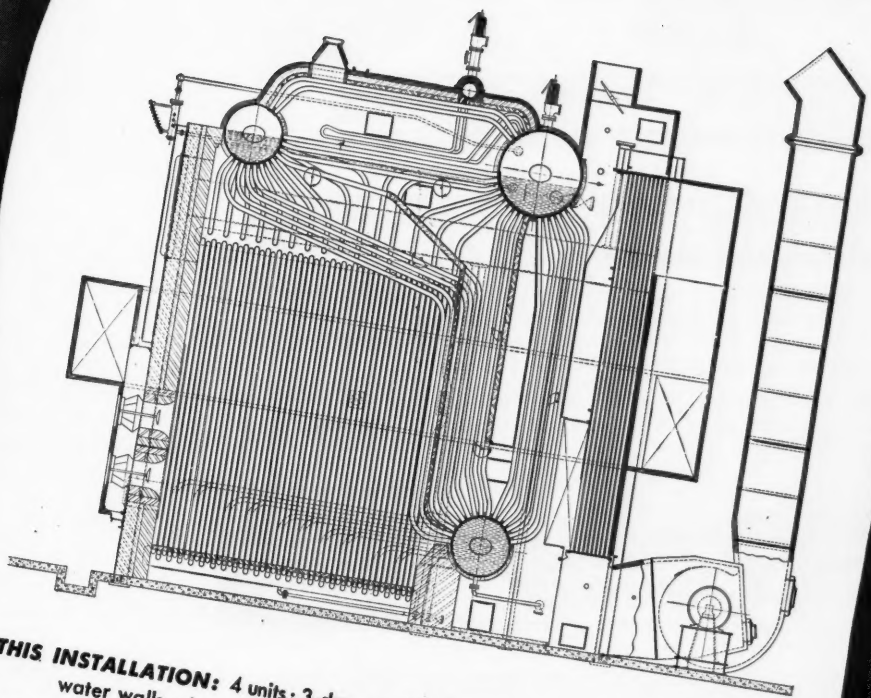
Electric Machinery will continue to operate independently of the other Worthington activities. Its present executive personnel, Walther H. Feldmann, president; O. A. Soderstrom, vice president in charge of manufacturing; R. H. Olson, vice president in charge of sales; and Fred W. Hotchkiss, secretary and treasurer, will continue in those capacities.

Dresser Manufacturing Co. has announced election of three vice presidents of the company. Those named are: J. B. O'Connor, Executive Vice President; Arthur R. Weis and Lyle C. Harvey, Vice Presidents.

The L. J. Wing Manufacturing Co., New York City, announces the appointment of the following new sales representatives for all Wing products: William H. Neville, Birmingham, Ala.; Johnson & Scott, Memphis, Tenn.; and Richard Barthelmess Sales Co., Jacksonville, Fla.

Crowley, Stapleton & Associates, Inc., is the firm name of a newly formed company which is the con-

EDGE MOOR WATER TUBE BOILERS



THIS INSTALLATION: 4 units; 3-drum, radiant heat, bent tube, with superheater, water walls, air preheater; oil fired.

CAPACITY . . . . . 110,000 lbs. steam per hour.

DRUM PRESSURE . . . . . 275 lbs.

DEGREES OF SUPERHEAT 20

FINAL STEAM TEMPERATURE . . . 430° F.

2 of the 4 boilers comprising this installation have now been equipped with spreader stokers and dust collectors for conversion to coal firing.

- Edge Moor Boilers are designed for any required steam capacity and up to 900 lbs. drum pressure. Complete installation service is available, including superheater, water walls, economizers and air preheaters.

STEAM GENERATING EQUIPMENT

EDGE MOOR

BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO 2, ILL.: ONE NORTH LA SALLE STREET

MAIN OFFICE: EDGE MOOR, DELAWARE

Specify
ECLIPSE
Seamless
WELDED STEEL HOSE
FOR

High Temperature Exhausts

ALSO

Seamless Parallel Corrugated

Because Eclipse Metal Hose is manufactured from seamless drawn tubing it is widely used for low-cost handling of oils, chemicals, refrigerants, and other non-solids, non-abrasives. Write us about your problems on conveying these fluids. Ask for bulletin with data on Eclipse Hose sizes and types.

Eclipse Seamless Welded Steel Hose has the flexibility needed to compensate for vibration or movement due to temperature changes. It cannot leak and will not burn out.

THE INVISIBLE CREW
Precision Equipment by
Bendix
AVIATION CORPORATION
Dept. 19-Phila. Div.-Philadelphia, Pa.

Also for
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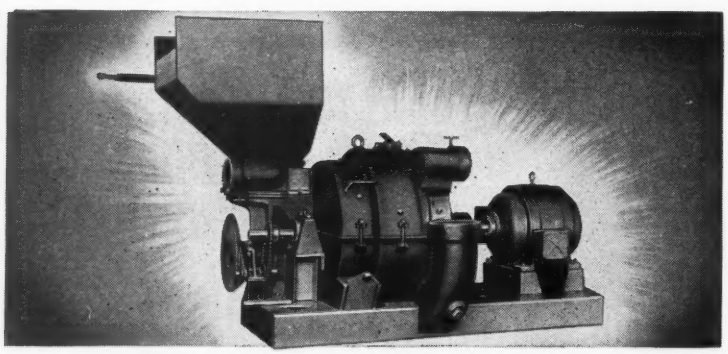
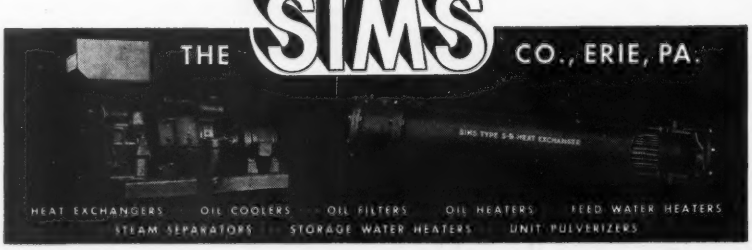


THE MODERN Sims-Pettibone Unit System of pulverization is applied successfully to boilers, metallurgical furnaces, kilns, stills, incinerators, dryers, etc., and is firing and burning bituminous coals, lignite coal, tar pitch and sewage sludge. Operating cost data on all of these experiences are available to help determine the value of an **S-P** Pulverizer for your plant. Write for booklet.

THE **SIMS** CO., ERIE, PA.



HEAT EXCHANGERS · OIL COOLERS · OIL FILTERS · OIL HEATERS · FEED WATER HEATERS
STEAM SEPARATORS · STORAGE WATER HEATERS · UNIT PULVERIZERS

solidation of the professional practices of Clyde A. Crowley, Ph.D., Consulting Engineer, and Royal L. Stapleton, Management Engineer and Consultant. Laboratory, library and general office will be located at 407 S. Dearborn St., Chicago 5, Ill., and the company will specialize in management, production, research and development. The staff will include Clyde A. Crowley, Ph.D., Royal L. Stapleton, Joseph C. Fasulo, Col. Henry L. Bowlby and Chester E. Willard.

Brown Instrument Co., Training School Division, Philadelphia, is now conducting the second 1944 industrial instrument maintenance and repair courses which started May 8 and will close August 4. Instruction is offered gratis to customers of the company who wish to send students to any of the various classes which run consecutively up to the closing date.

The new courses and the dates of each course are: Millivoltmeter type pyrometer, May 8 to 25; Mechanical potentiometer pyrometer, May 26 to June 14; Continuous balance electronic type pyrometer, June 15 to June 22; Electrically operated automatic control, June 23 to June 30; Flow meters, July 3 and 5 to July 12; Thermometer-pressure gage-hygrometer, July 13 to July 20; Air operated automatic control, July 21 to July 28; CO_2 and analygraph, July 31, and Resistance thermometer and tachometer, August 1 to 4. All the subjects include laboratory practice.

Thompson Pipe and Steel Co. of Denver, Colo., will represent Yeomans Brothers Co. in the sale of all Yeomans products in Colorado and in the sale of sewage pumps and sewage treatment equipment in the states of Wyoming and New Mexico.

Cutler-Hammer, Inc., Milwaukee, Wis., announces the moving of its Portland Sales Office to new quarters in the Security Building, 131 S.W. Fourth Ave., Portland 4, Oregon. This new office provides excellent facilities for handling the increased business in the Portland area. Frank J. Woldrich, Sales Engineer, is in charge.

The Bristol Co., Waterbury, 91, Conn., announces the opening of a new Cleveland branch office, located in the Engineer's Building, Cleveland 14, Ohio, which will serve the states of Kentucky and Ohio with the exception of the Toledo area. Announcement is also made of the appointment of G. H. Gaites as Regional Sales Supervisor of the Cleveland and Pittsburgh territories. H. C. Clarke has been made District Manager of Bristol's Pittsburgh branch office. Mr. Clarke goes to his new position from Buffalo where he has been Resident Sales Engineer.

The Bristol Co., Waterbury 91, Conn., has recently opened a new branch office in Houston, Texas, which is located in the Citizens State Bank Building and will serve the states of Louisiana and Texas with the exception of the Panhandle section. D. D. Ault who has been resident sales engineer in Houston for The Bristol Co. for a number of years will be in charge of the new office.

Hanlon-Waters, manufacturer of control instruments for the oil and synthetic rubber fields, has been acquired by interests owning McAlear Manufacturing Co. and Climax Engineering Co., and in the future will be operated as a division of the latter

Scale-smashers by ELLIOTT

This group of aids to boiler health is a small part of many now in service on Maritime Commission vessels. These cleaners, all water-driven, are for 2 in. and 4 in. tubes. The larger cleaners are equipped with universal joints for use in curved tubes.

Afloat and ashore, Elliott tube cleaners are at their best in any tube that can be cleaned. They combine powerful motors, armed to the teeth with tough, hard, trackless cutters in cutter heads that will stand the gaff of heavy service. They are the final up-to-the-minute word in scientifically designed tube cleaning equipment, developed through many years of research and experience.

If you have a tube cleaning problem, Elliott has the tool for it and the experience to back it up. Write us.

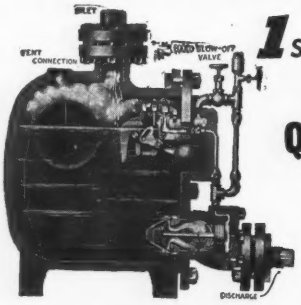
ELLIOTT COMPANY
TUBE CLEANER DIVISION, SPRINGFIELD, OHIO
DISTRICT OFFICES IN PRINCIPAL CITIES

Elliott cleaners

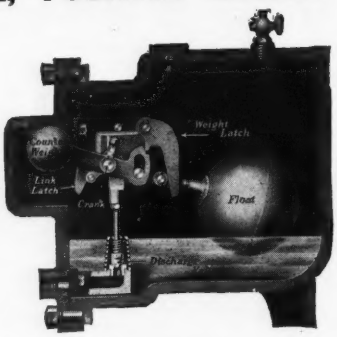
for tubes of every kind, everywhere

Y-219

NICHOLSON STEAM TRAPS



1st Choice of Engineers who Have Discovered Their
QUICK, POSITIVE ACTION



PISTON-OPERATED STEAM TRAP

1) For pressures up to 650 lbs.
2) Positive, instantaneous discharge.
3) Non-wire-drawing valve.
4) Working parts of stainless steel.
5) Non-collapsible float.
6) Larger orifices.
7) Smaller size; larger capacity.

FOR COMPLETE FEATURES OF NICHOLSON TRAPS
Write for Catalog No. 941
See Our Catalog in Sweets

Weight-Operated Steam Trap

1) For pressures up to 1500 lbs.
2) Automatic, intermittent action.
3) Large capacity.
4) Resists action of dirt, vibration.
5) Non-wire-drawing valve.
6) Water-sealed discharge valve.
7) Working parts of stainless steel.

W. H. NICHOLSON & CO.
160 OREGON ST., WILKES-BARRE, PA.

TAYLOR-*Standard of Accuracy*

Simple 3 Minute

BOILER WATER ANALYSIS

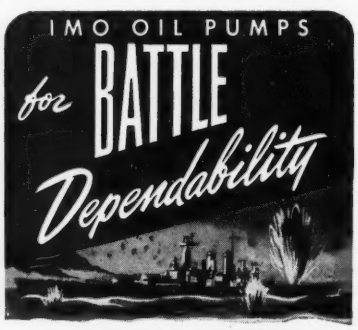
determines Silica in boiler water . . . Ammonia content and pH of condensate. Color standards are securely contained in sturdy, non-warping plastic slide, thus eliminating necessity of handling cumbersome, fragile, expensive Nessler tube standards. Accuracy is assured for all Taylor liquid color standards carry AN UNLIMITED GUARANTEE AGAINST FADING.

Taylor Water Analyzer, with any one color standard slide, complete $18.00 F.O.B. Baltimore. Additional slides, each $8.00.

See your dealer or write for booklet, "Modern pH and Chlorine Control"

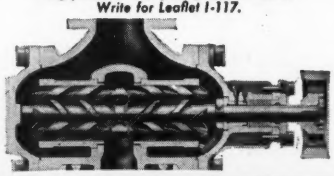
W. A. TAYLOR AND CO.
7301 YORK RD. • BALTIMORE 4, MD.

IMO OIL PUMPS *for* BATTLE *Dependability*



A cruiser of the U. S. Navy, one of the classes of ships equipped with De Laval-IMO oil pumps

On fighting ships, where reliability and dependability under strain are all important and where space is at a premium, many thousand IMO oil pumps are in use pumping fuel oil, circulating lubricating oils, and operating hydraulic machinery. The simplicity of construction and operation that makes the IMO pump so dependable in battle assures the commercial user of long life and trouble-free operation. This unique pump has practically nothing to get out of order; it has only three moving parts, and no pilot gears or valves.
Write for Leaflet I-117.



IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton 2, New Jersey

group, under continuing Hanlon-Waters management. McAlear Manufacturing Co., Chicago, is the maker of similar control devices used principally for industrial and heating service.

Fairbanks, Morse & Co. announces the opening of a new office in Tulsa, Okla. The office is under the management of Frank D. Ratcliffe, District Manager, Oil Industry Sales, and is located at 1335 Hunt Building.

The newly formed General American Process Equipment Division of the General American Transportation Corp. of Chicago, Ill., has opened offices at 420 Lexington Avenue, New York.

Among the members of this new organization are H. M. Hunter, formerly Vice-President and Manager of Sales, P. B. Sadler, Chemical Engineer, and G. D. Dickey, Manager of the Filter Department, of Goslin-Birmingham Mfg. Co., Inc., Birmingham, Alabama. These three gentlemen recently organized the Conkey Co. as successor to the Conkey Filter Co. which itself was successor to Industrial Filtration Corp. and Moore Filter Co., the latter having been founded by George Moore, one of the pioneers in the filtration field. The Conkey Co. will devote its efforts to the filter and evaporator equipment line of the above division. Companies comprising this new division also include the Louisville Drying Machinery Co., the Conkey Co., the Turbo-Mixer Corp. and the American Machine Co.

The Wm. Powell Co., at its annual meeting April 25, reelected the following officers: H. H. Coombe, Chairman of the Board and Treasurer; James Coombe, President and General Manager; Geo. E. Weitkamp, First Vice President and Secretary; Vice Presidents David Forker, Oliver F. Gang, Wm. Heilig, and Elmer R. Noll. The newly elected Vice Presidents are: Wm. R. Kraus, Wm. E. Minor, Harry C. Morine, E. K. Pierce, and E. W. Voss. Wilton Husing was given the position of Assistant to the President.

Kieley & Mueller, Inc., North Bergen, N. J., has appointed The Willis Engineering Co., 230 West Jeffrey Place, Columbus, agent for the State of Ohio, and Garrard & Seat, 313 Bona Allen Building, Atlanta, agent for the entire State of Georgia.

The Oakite Third War Production Conferences on cleaning, de-scaling, de-rusting, de-greasing and related production and maintenance operations were recently held in New York, Chicago and Los Angeles. Participating with the entire field technical service representatives were the staffs of the mechanical engineering, chemical and research laboratories and general headquarters of Oakite Products, Inc.

These two-day sessions were devoted to techniques for prolonging equipment life; improving plant sanitation and maintenance; faster, more thorough cleaning in repair and overhaul procedures.

Technical service representatives revealed newly-devised, time- and effort-saving techniques for expediting maintenance work on heat exchangers, Diesel engine cooling systems, lube oil coolers, transformers, oil preheaters and many other types of power plant equipment; stripping paint from transformers; slime control in air conditioning and humidifying systems.

PRODUCT OF THE MONTH

Texrope Super-7 V-Belts result from the cooperative research and design of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

MILWAUKEE, WIS. — Allis-Chalmers announces the Texrope Super-7-Steel . . . a new V-belt employing endless steel cables to provide greater horsepower transmission, reduce belt stretch. For proper applications of Super-7-Steel, check with nearby Allis-Chalmers district office or Texrope dealer.

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ALLIS-CHALMERS · MILWAUKEE · WISCONSIN

Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.

No Other Refractory Coating Is Like BRICKSEAL

* Forms a highly-glazed, protective, monolithic surface

Brickseal is the only refractory coating we know of which consists of high-fusion clays and metals combined with oils. Unlike air-set washes which form only a plaster-like coating on the refractory surface, Brickseal actually becomes an integral part of the brickwork. The heat of the fire-box drives out the oils and vitrifies the clays and metals, penetrating deeply into brick pores, cracks and joints, and forming a highly-glazed, air-tight, monolithic wall.

Brickseal cannot crack, blister or peel off due to sudden temperature changes because it remains semi-plastic until the furnace cools, when Brickseal becomes hard as steel. Boiler can be used immediately after Brickseal application. The glossy Brickseal surface reflects heat, prevents air infiltration, and helps produce more steam with less fuel. Maintenance expense due to cracking, spalling or erosion is reduced or eliminated entirely with Brickseal.

Brickseal is applied easily with brush or spray gun. Its cost is insignificant compared with the results it produces.

Write for sample or Brickseal representative.

BRICKSEAL
REFRACTORY CO.
1029 CLINTON ST., HOBOKEN, N. J.

NEWS FROM THE FIELD

A S M E Meeting at Pittsburgh

SINCE the ASME Semi-Annual meeting on June 19 to 22 is being held in Pittsburgh the program is built to a large extent around the interest of the Society members in iron and steel products and coal, materials for which the district is famous throughout this country. Several sessions of the meeting are to be devoted to the discussion of topics of extreme interest to power engineers and attention is given here only to those papers on the program which have a bearing on the economics of power generation and use. Following, therefore, are the portions of this program selected for their interest to power plant engineers:

June 19, 2:30 p. m. Lubrication Session: The Friction Properties of Various Lubricants at High Pressures, by John Boyd and B. P. Robinson. Investigation of Friction and Wear under Quasi-Hydrodynamic Conditions, by R. G. Larsen and G. L. Perry.

June 19, 7:30 p. m. Metal Engineering—Applied Mechanics Session: Machines for Testing Creep and Fracture of Metals at Very High Temperatures, by M. J. Manjoine. Making Joints in Aluminum, by M. A. Miller, E. C. Hartman, and G. O. Hoglund.

June 19, 7:30 p. m. Panel Discussion on Recent Developments in Industrial Furnaces, under the auspices of the Industrial Furnaces and Kilns Committee, Heat Transfer Division.

June 20, 9:30 a. m. Fuels Session: The Fuel Investigation Precedes Power Plant Design, by E. C. Payne. Coal Segregation in Boiler Plants, by Arthur J. Stock.

June 20, 2:30 p. m. Heat Transfer Session: Heating-up Time and Energy Losses of Furnaces, by V. Paschkis. Economic Thickness of Insulation for Intermittent Operation, by V. Paschkis, C. E. Ernst and C. B. Bradley.

June 20, 8:00 p. m. Symposium on Adjustment of Floating, Corresponding or Derivative Control Actions—Industrial Instruments and Regulators.

June 20, 8:00 p. m. Fuels Session: Factors Affecting the Thickness of Slag on Furnace Wall Tubes, by W. T. Reid and P. Cohen. The War Problem of Increasing the Utilization of Small Anthracite, by J. F. Barkley and L. D. Schmidt.

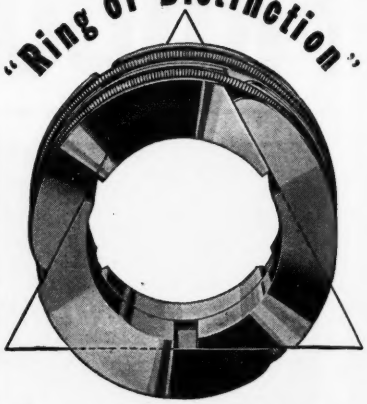
June 21, 9:30 a. m. Power Session: Package-Type Power Plants, by H. H. VanKennen and Lester E. L. Wahrenburg.

June 21, 9:30 a. m. Heat Transfer Session: Countercurrent and Cross Flow Cooling Tower Calculations, by M. P. Peet. Variable Heat Transfer Rate Correction in Multipass Exchangers—Shell Side Film Controlling, by K. A. Gardner.

June 21, 2:30 p. m. Symposium on Controlled Atmospheres Metal Processing Process Industries—Metals Engineering.

June 21, 2:30 p. m. Heat Transfer Session: The Design of Heaters for the Petroleum Industry, by J. H. Rickerman. Experimental Confirmation of Predicted Water Freezing Rates, by

"Ring of Distinction"



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Metal Packing
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The renewal of ordinary packing every few weeks or months increases horsepower and production costs.

Minimum friction is encountered with France Metal "Ring of Distinction" Packing. No undue force can be exerted on rods or stems by tightening the stuffing box stud nuts. The rings are free to float in the case that retains them and are held to the rod or stem with a garter spring having minimum tension.

The result is tight "full-floating", trouble-free performance for years. Prompt delivery assured.

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44-page Catalog of useful and valuable information. Write for your free copy of Catalog M-5, with facts on

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Request France Engineers to analyze your packing requirements. There is a representative close at hand.

THE FRANCE PACKING COMPANY
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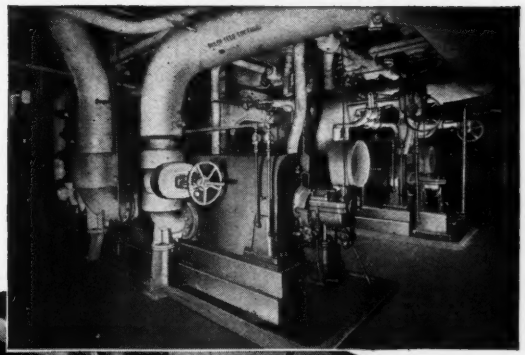
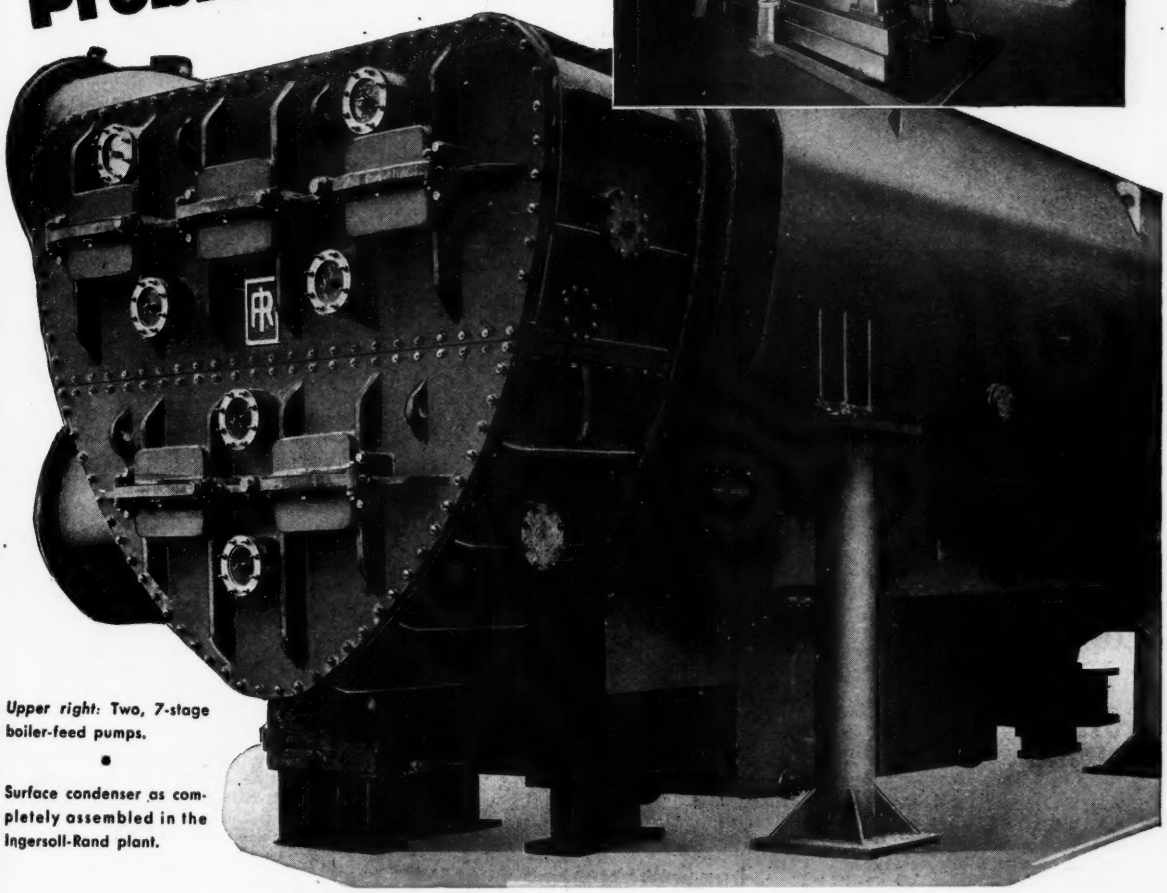
A TOUGH Problem Solved





Upper right: Two, 7-stage boiler-feed pumps.

•

Surface condenser as completely assembled in the Ingersoll-Rand plant.

Highly corrosive circulating water caused a large New England electric utility company to use jet condensers on their earlier installations. However, when a 40,000 KW extension was proposed, it was evident that a suitable surface condenser would have to be used to provide pure feed water for a modern 1350 psi. boiler.

The electric company and its consulting engineers conducted an extensive study in order to determine the best tube material. They consulted with Ingersoll-Rand regarding the design and construction of the condensing plant, particular attention being given to the water-box design, tube ends, and circulating pump construction.

This resulted in the selection of an Ingersoll-Rand 28,500 sq. ft. surface condenser with divided water boxes, two vertical circulating water pumps, and two condensate pumps.* It was a good selection as attested by more than 2 years of excellent performance under severe war-time peak loads.

This is an example of Ingersoll-Rand engineering service. May we help you? Ingersoll-Rand Company, Cameron Pump Division, 11 Broadway, New York 4, N. Y.

**Other Ingersoll-Rand pumps in this extension include two boiler-feed units and twelve miscellaneous pumps.*

4-317

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES **Ingersoll-Rand** CONDENSERS • CENTRIFUGAL PUMPS

VIKING

ENGINE *ALARM* SYSTEMS

TYPE M

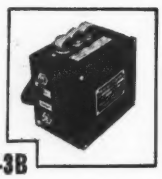
CONTACT MAKERS

Pressurestatic or Thermostatic Contact Makers for lubricating-oil or circulating-water systems for all types of stationary or mobile equipment.

Now available in sheet-steel housing to avoid critical materials.

Can be supplied with complete indicating system.

COMPLETE ALARM SYSTEM



TYPE M-3B

Complete alarm system consists of Type M-3B combination pressure control, junction box and visual indicator, together with Type M Thermostatic Contact Maker, and signal howler.

WATER- AND WEATHER-TIGHT

TYPE C

CONTACT MAKERS

Where Contact Maker is exposed or must be waterproof, Type C Pressurestatic or Thermostatic is recommended.

Manufacturers of engine alarm systems, annunciators, marine and industrial instruments. Write for specifications.

VIKING INSTRUMENTS, INC.

418 Fairfield Ave., Stamford, Conn. Telephone 4-7375

R. E. Seban and A. L. London.

June 22, 9:30 p. m. Power Session: Steam Turbine Designer's Reliance on Research and Experimental Laboratories, by C. C. Franck.

June 22, 2:30 p. m. Hydraulic Session: Cavitation Characteristics of Centrifugal Pumps, by A. J. Stepanoff. Some Characteristics of Rotary Pumps in Aviation Service, by P. J. S. Pigott. Friction Factors for Pipe Flow, by Lewis F. Moody.

Illinois Northern Utilities To Expand Dixon Plant

ILLINOIS NORTHERN UTILITIES Co., Dixon, Ill., affiliated with Commonwealth Edison Co., Chicago, Ill., will begin work soon on new addition to local steam-electric generating station, with installation of a 50,000-kw turbine-generator unit, high-pressure boilers and auxiliary equipment. Work will include construction of a new steel frame addition for extensions in steam division, and contract for structural steel requirements has been awarded to Mississippi Valley Structural Steel Co., Decatur, Ill. Project has been pending for a number of months and recently has been given a priority rating by WPB. Cost is estimated close to $6,000,000, including additions to switchyard, transmission lines, power substations and other operating facilities. Completion is scheduled in early fall of 1945. Sargent & Lundy, 140 South Dearborn St., Chicago, are consulting engineers.

Pacific Power & Light To Build Hydro Station

PACIFIC POWER & LIGHT Co., Portland, Ore., has plans under way for a new hydroelectric power plant on Crooked River, near Cove, Ore., with initial capacity of 1500-kw, designed to replace a similar generating station at Bend, Ore., where Deschutes irrigation project of Government will divert water supply necessary for plant operation. Cost is estimated about $300,000, including transmission line. Application has been made for a priority rating, expected to be granted soon, when work will be placed under way.

Coordinators Start Fuel Economy Surveys

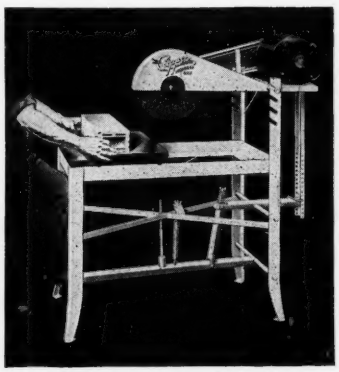
APPOINTMENT of 58 additional coordinators in the national fuel-efficiency program was announced on May 17 as signed pledges of cooperation from scores of industrial executives in all parts of the United States began coming in to the Bureau of Mines at Washington, D. C.

Now totaling 76, the list of coordinators who will direct a staff of approximately 5000 regional engineers—including some of the nation's foremost fuel experts—is expected to reach 300. These thousands of volunteers, mostly from industry, are serving without compensation to help the National Fuel-Efficiency Council and the Bureau of Mines achieve their campaign goal—a 29,000,000-ton reduction in the annual commercial and industrial consumption of coal and proportionate savings in other fuels.

Having completed the organization of local advisory committees, many of the coordinators have sent their staffs of regional engineers into action, calling at industrial and com-

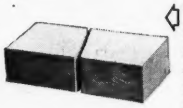
FASTER CUTTING ...with Clipper Masonry Saws

Your Special Size and Shape Brick or Tile can now be "Tailor-Made" at a moment's notice!



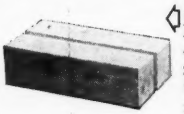
The new Clipper Multiple Cutting Principle makes possible faster cutting of every masonry material regardless of hardness.

Here are a few typical examples of the speed and accuracy with which fire brick can be cut for furnace repairs.



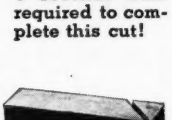
This acid brick intended for a chemical plant acid chamber was cut completely in two, in 37 sec.

One of many intricate cuts performed on first quality clay brick for heat treating furnaces. Made in 8 seconds.



Silica brick cut lengthwise for open hearth furnace work, only 9 seconds were required to complete this cut!

Basic refractories for steel furnaces or cement kilns must be accurately installed. This magnesite brick was cut in 12 seconds!



Clipper Saws are available for trial. Write for Descriptive Catalogs.

THE Clipper CUTS RIGHT THRU MANUFACTURING COMPANY

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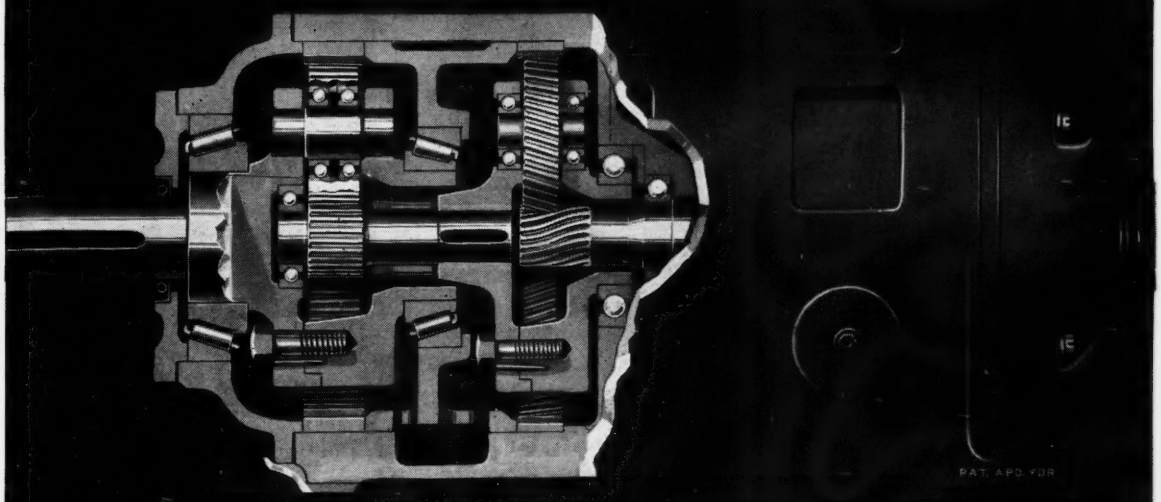
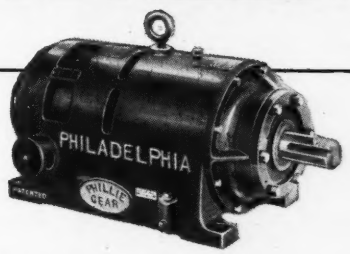
NO OVERHUNG PARTS



Philadelphia
MOTOREDUCER



...Drive operates without Vibration

Both the horizontal and vertical MotoReduceR combine a motor and planetary speed reducer in a single housing. This results in an attractive streamlined effect that enables the MotoReduceR to blend with, and appear to be an integral part of any machine on which it is installed. More important though is the resulting better alignment of pinions and gears, which reduces noise and wear and conserves space. *Because there are no overhung parts, vibration is eliminated and proper tooth alignment is maintained at all loads.* All parts, however, are readily accessible.

The MotoReduceR will operate efficiently for years, without any attention except periodic changes of lubricant.

A wide range of sizes and ratios are available with standard A.G.M.A. ratings.

For complete information ask for catalog MR. 40 . . . on your business letterhead please.

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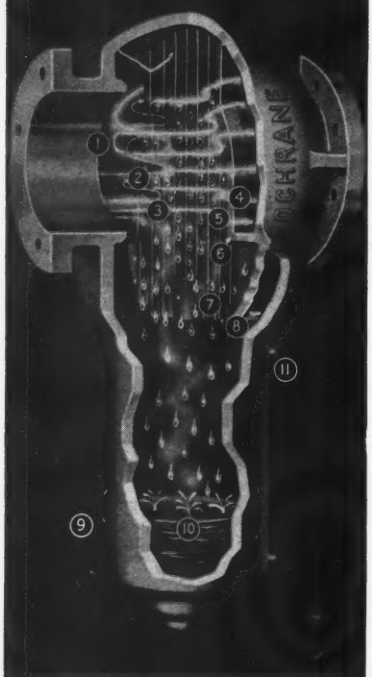
is the most widely used and most successful type of separator for removing oil or water from steam or air...



1. Exceptional Port Area
2. Complete Removal of Entrainment
3. Self Cleaning
4. Purified Steam or Air Does Not Contaminate Entrainment
5. Steam or Air is Whipped Sidewise by Ports at Side of Baffle
6. High Ribbed Edge of Ports Prevents Entrainment Passing Baffle
7. Entrainment has Direct, Unrestrained Fall
8. Separating Shell
9. One Piece Construction
10. Condensate Chamber of Large Capacity
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mercial plants in their area to analyze fuel-utilization conditions, to offer suggestions for greater operating efficiency, and to distribute special technical literature prepared for the program by experts in the operation and maintenance of various types of fuel-burning equipment. Additional fuel economies, which may yield even greater results, will be sought outside the boiler rooms by promoting the use of insulation and the conservation of electricity, steam, hot water, compressed air, and other sources of heat and energy stemming from fuel.

Reports from coordinators and regional engineers throughout the country to Thomas C. Cheasley, supervising engineer for the Bureau's Fuel-Efficiency Section, indicate that plant managers are welcoming not only the expert technical advice, given without charge, but the opportunity to help their country solve the serious problems of wartime fuel shortages.

New Officers for Detroit Edison Co.

ACCEPTANCE of the resignation of Alfred C. Marshall as president and election of Prentiss M. Brown a director and chairman of the board and James W. Parker as president of Detroit Edison Co. has been announced by the directors of the company. At the company's request, Mr. Marshall has served for sometime beyond the retirement age fixed by the company's retirement plan. He will continue as a director and as an active consultant in the company's affairs. This action of the board of directors at their regular May meeting followed previously announced plans, according to Russell W. Symes, secretary.

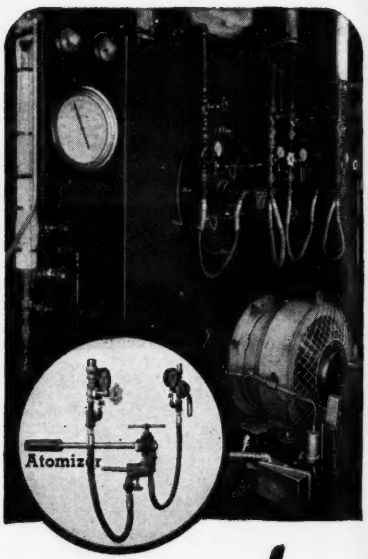
Mr. Brown, a lawyer and former United States Senator from Michigan, has had wide experience in national affairs, including banking and industrial developments in Michigan.

Mr. Parker has been with The Detroit Edison Co. since 1910 and is at present a director and general manager—positions he will continue to fill in addition to the presidency.

Network Analyzer at Purdue

APPROPRIATE CEREMONIES attended by executives of seven midwest utilities were carried out at Purdue University on May 9 when the new network analyzer was officially put into service. The power companies represented, all of which cooperated in the purchase and installation of the analyzer which will be used in studying problems which arise in the operation of electric networks, included the American Gas and Electric Service Corporation, Cincinnati Gas and Electric Co., Dayton Power and Light Co., Indianapolis Power and Light Co., Louisville Gas and Electric Co., Northern Indiana Public Service Co., and the Public Service Co. of Indiana.

Time for use of the analyzer in solving power problems will be made available to the cooperating organizations on an equal basis while other utilities can obtain operation time upon application to the University. The University expects to utilize its share of the time on the board for instructional and research purposes. The analyzer was constructed by Westinghouse Electric & Mfg. Co.



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Enco Burners

FOR ALL GRADES OF LIQUID FUEL

Enco Burner Units of Steam or Mechanical Atomizing Types are made in various sizes with capacities from 1 to 1000 gallons per hour.

Designed for operation either with or without air registers and for natural or forced draft.

The Enco Interchangeable Atomizer is made for instant change of guns for operation by either steam or mechanical system or to cover a wide range of capacity.

Enco Atomizers are used with various types and makes of pulverized-coal and gas-burner units to provide a dual fuel unit for cold starting, or for full-load operation when coal or gas is not available, or use when oil is the more economical fuel.

We have made many installations during the past 25 years and are ready to cooperate with those looking for better operation and assurance against loss of steam output.

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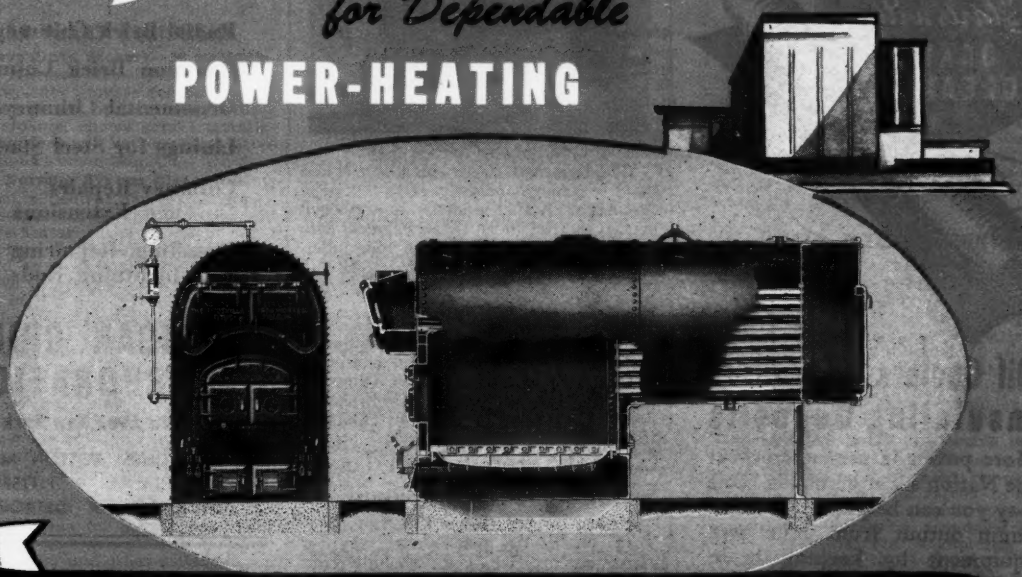
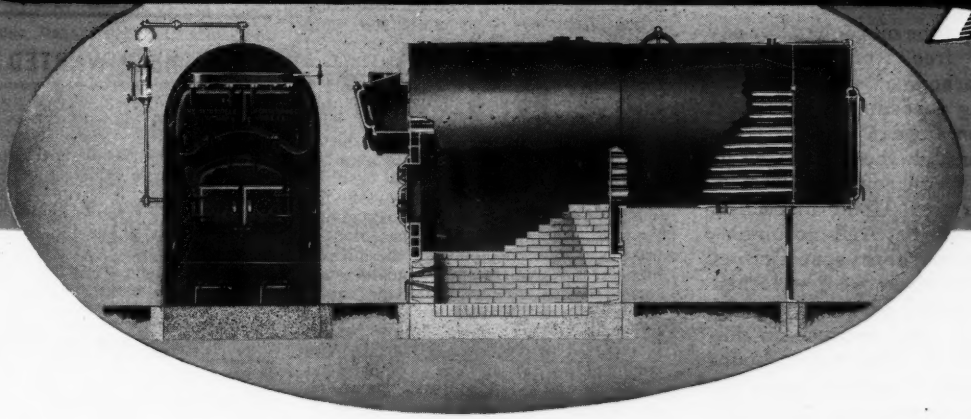
Fire Box Boilers

for Dependable

POWER-HEATING



FOR COAL, OIL OR GAS OPERATION . . .



TITUSVILLE ENGINEERS, armed with the facts about needed pressures, temperatures, type of service, allotted space for the installation will quickly present blueprints for the *boiler you need*—designed from the accumulated knowledge of successful boiler building for over fifty years. We invite you to use this boiler engineering service, for new installations or replacements, anytime, anywhere.

Built to ASME Boiler Code specifications

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TITUSVILLE BOILER DIVISION

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PLANTS AT TITUSVILLE, PENNA. AND WARREN, PENNA.

. . . Keep Lube Oil Coolers Free From Insulating Deposits

More power is needed to meet the Nation's war demands. One way you can help is to get maximum output from your own equipment by keeping it in CLEAN, EFFICIENT operating condition.

To keep lube oil coolers, for example, free from lime-scale, rust, carbonized oil or other insulating deposits, just circulate a recommended Oakite solution through the water side or oil side of the cooler as directed. Then rinse. Upon inspection you'll find that ALL accumulations have been speedily yet SAFELY removed. Normal heat transfer efficiency is fully restored. And because no dismantling is required, man-hours are saved . . . units are returned to service without undue delay!

WRITE FOR FREE MANUAL
giving time-saving tips for cleaning lube oils coolers, preheaters, jacket-water coolers, feedwater heaters, evaporators, transformers.

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Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE Specialized cleaning
Buy Bonds for Victory
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

Diesel-Electrics in Hawaii

To THE FLEET of approximately 25 steam engines operated in Hawaii by the Oahu Railway & Land Co. have been added two 47-ton 380-hp, Diesel-electrics made by the General Electric Co. These first full-sized Diesel-electrics for general railroad use ever brought to the Islands were recently put in operation.

The new units were specially adapted by G. E. from standard gage to the 36-in. O.R.&L. tracks. Electricity is developed by two eight-cylinder Diesel engines, with motor drive for each of the four axles. Each unit has a fuel capacity of 250 gal, sufficient for about 50 hr of service without refueling.

The new additions to the O.R.&L. rolling stock will be used regularly in the transportation of war materials and other freight to destinations served by the railway, and in hauling supplies from plantations and mills to the docks in Honolulu and the pineapple canneries.

Consolidated Edison To Expand Hell Gate Plant

CONSOLIDATED EDISON CO., INC., New York, N. Y., has plans under way for expansion in Hell Gate steam-electric generating plant, East River and 134th St., including construction of new multi-story steel frame addition, requiring about 2800 tons of structural steel, and installation of equipment for increased capacity. Contract has been awarded to General Electric Co., for a 65,000-kw topping turbine unit, designed to use steam at a pressure of 900 lb, and with exhaust steam to be utilized for operation of present low pressure turbines for additional output. This dual use of steam will increase capacity of the plant by 126,000-kw, it is stated, giving the station a gross rated output of 615,000-kw. Other equipment will include high-pressure boilers and complete accessories, switchgear and auxiliary equipment, for which awards are scheduled to be made at early date. Entire project is reported to cost over $5,000,000, with completion in fall of 1945. Company has taken out a permit to make alterations and improvements in present station, to accommodate the expansion program, estimated to cost about $500,000, and has placed contract with Bethlehem Steel Co., Bethlehem, Pa., for required structural steel. Project has a priority rating.

WPB Approves Three New Generating Units

THE OFFICE OF WAR UTILITIES has assigned AA-3 ratings for the construction of three new steam turbine-generators. At the Atkinson plant of Georgia Power Co., a 60,000-kw unit will be installed; at the Springdale plant of the West Penn Power Co. a 65,000-kw unit; and at the Dixon plant of the Illinois Northern Utilities Co. a 50,000-kw unit. They are all scheduled to go into service in 1945.

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HELP WANTED

MECHANICAL and ELECTRICAL ENGINEERS — Experience required on power plant and general piping design by a large midwest concern manufacturing a wide variety of communication and electronic equipment. In reply submit snapshot, give age, experience and salary expected. Box 1441, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

POSITION WANTED

GRADUATE ENGINEER, 40, married, 15 years' experience in high pressure plants' operation and testing, familiar with automatic controls, specialized in efficient burning various fuels, seeks responsible position with industrial power plant or public utility. Address Box 1440, Power Plant Engineering, 420 Lexington Ave., New York.

Position Wanted: Power Plant Manager, 25 years' experience in Plant Operation and Maintenance, Organization and Personnel Management. Desires permanent postwar position. Can furnish references. Address Box 1442, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature available. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on coupon on next page, detach and mail.

BOILER PLANT EQUIPMENT

1 **Heavy-Duty Stokers**—20 pg bulletin features Iron Fireman Poweram heavy-duty stokers for boilers developing up to 400 hp; outlines features of these stokers, shows actual installation photographs and lists representative users. Iron Fireman Mfg. Co.

2 **Oil Burning System Cleaner**—How Fusol, a neutral non-corrosive solvent, dissolves sludge in oil tanks and cleans pre-heater tubes is outlined in new bulletin. Treated with Fusol, fuel oil is said to maintain a uniform viscosity, give better atomization. Maxfal Chemical Co.

3 **Boiler Baffle Savings**—Greater fuel economy or steam generating capacity frequently can be obtained by modernizing baffles and furnaces. New bulletin "Economy Boiler Baffles" explains how significant savings can be effected by proper baffle design. Blueprints show the old and new location of baffles together with an account of savings made in each case. The Ramtite Co.

4 **Streamlined Coal Storage**—Suggested ideas for constructing concrete storage bins for storing coal, oil, chemicals, water and other materials are presented in new bulletin. A helpful reference for those planning to expand or revamp present bulk storage facilities. The Nicholson Co.

5 **Boiler Data Book**—Bulletin B-44-5-M on the S-A type boiler has been issued by Foster Wheeler Corp. It contains drawings and photographs, together with operating data at a number of well known plants. Method of operation, ability to fire two or three different fuels simultaneously are given; also numerous photographs showing close-up details of construction. Simplified 2-pg chart giving the heat content of steam will also be found very helpful.

6 **Curtain Type Dampers**—In a 12-p well illustrated bulletin, the new Heacon damper, a flexible curtain type damper designed for steam generating units of capacities up to 300,000 lb per hr and for process furnace and other process applications, is described and illustrated in detail. Data are given on leakage comparisons with other types of dampers, curves of the Heacon damper characteristics are shown, and data are given on specific installations of the unit. Thermix Engineering Co.

7 **How To Sample Coal Automatically**—Bulletin No. 85 points out how many engineers use automatic mechanical sampling to eliminate hand labor, delays and errors. Also describes construction and operation of the improved Sturtevant coal crusher and sampler. Sturtevant Mill Co.

ELECTRICAL

8 **Summary of Transformer Savings**—Profusely illustrated 16 pg Bulletin GEA-4193 is entitled "Summary of safety and savings with all purpose Pyranol transformers." These units are insulated and cooled with a liquid that will not burn; show economies in space, material and operating costs. General Electric Co.

9 **Practical Design For Arc Welding**—Handy loose-leaf sheets pass along practical tips on arc welding foundation lugs, gear case corners, light pedestals for machinery bases, medium size gear blanks, etc. Simple sketches illustrate each design. Hobart Bros. Co.

10 **Making Motors Last**—"Hints to Make Motors Last" is the title of handy little booklet for engineers and maintenance men. Check chart tells what to do when motor fails to start, runs hot, is noisy, shows excessive brush wear, etc. Westinghouse Electric & Mfg. Co.

11 **Resistance Welding**—New 28 pg Bulletin GET-1189 includes a master chart of various welding processes; discusses factors determining use of resistance welding, welding electrodes and their maintenance, material and its preparation for welding. A helpful know-how handbook for those interested in modern metal fabrication. General Electric Co.

12 **New Electrical Symbols Chart**—A new chart of electrical symbols for power, control and measurement, both in one line and complete wiring diagrams, is included in Bulletin 4403 published by The I-T-E Circuit Breaker Co. Bulletin is only 8½ in. by 11 in. in size, allowing it to be kept in a desk drawer, but can be unfolded to 17 in. by 22 in. for use as a wall chart or spread under a glass table top. The symbols chart is in blueprint style and lacquered to withstand frequent handling without soiling. Contains more than 500 symbols and switch sequence tabulations.

13 **Flip-Open Fuse Cutouts**—Bulletin GEA-4224 shows construction details of G-E flip-open fuse cutouts, 50 a 7500/12,500 and 15,000 v. This unit provides overcurrent protection by means of a fuse link, but without the conventional hinged fuseholder tube. General Electric Co.

FANS, PUMPS AND COMPRESSORS

14 **Gas Engine Compressors**—Bulletin L-690-B1 describes outstanding accessibility and low installation cost of the Worthington LTC gas engine compressor. Five sizes available: 400, 500, 600, 800 and 1000 bhp. Worthington Pump and Machinery Corp.

15 **Handbook On Centrifugal Pumps**—Allis-Chalmers' wartime pump maintenance handbook gives a grand "refresher" course in alignment problems, figuring head, making shafts last longer, preventing cavitation, etc. Applies to all makes of pumps. Allis-Chalmers Mfg. Co.

16 **Cycloidal Rotary Pumps**—Roots-Connersville Blower Corp. has just issued Bulletin 61-B11, devoted to its cycloidal rotary pumps. This 4 pg folder shows various driving arrangements, including direct coupled electric motors, gasoline and steam engines, in addition to standard arrangements such as flat belt or V-belt, gear reducers, etc. A cross-sectional view shows the three-lobed impellers which are use in both the type "RF" and "SO" pumps.

17 **Compressors And Vacuum Pumps**—Ingersoll-Rand announce a new 32 pg catalog of compressors and vacuum pumps in sizes from ½ to 10 hp. This bulletin covers the well-known Type "30" line of air-cooled machines with two notable additions, a 3-stage dual-pressure portable and two 3-stage high-pressure units. The dual-pressure portables are designed particularly for use at airports in the servicing and repairing of airplanes. They may be operated either at 80 to 100 lb discharge pressure, or 1600 to 2000 lb, the manipulation of a single valve changing from one pressure range to the other.

INSTRUMENTS AND CONTROLS

18 **Measuring Flow Through Turbines**—New Simplex Bulletin No. 420 describes the W-K principle and Type MO meter for measuring flow through water turbines. Comparison between Kilowatt Output chart and Simplex Water Input chart and other useful data are shown, together with list of representative installations. Simplex Valve & Meter Co.

19 **Cooling Controls**—Twelve pg bulletin No. 700 on Sarco cooling controls, covers self-operated temperature regulators and mixing valves, to control cooling circuits on internal combustion engines, compressors, condensers, degreasers, stills, etc. Completely illustrated, including many typical hook-ups, capacity tables, prices, etc. Sarco Co., Inc.

20 **Motor Control Renewal Parts**—The job of ordering motor control parts is simplified by the new free Cutler-Hammer Renewal Parts Guide. Also includes many practical maintenance ideas for prolonging the life of controllers, resistors, magnets, brakes and clutches. Cutler-Hammer, Inc.

21 **Feed Water Regulator**—Bulletin 435 summarizes the performance record of Copes Flowmatic, the steam-flow water-level feedwater regulator. Folder reviews the wide acceptance of the Flowmatic throughout many industries on various types and sizes of boilers, and the results obtained by users. Northern Equipment Co.

22 **Condensate Purity Instruments**—Anyone in steam plant or process industry who is concerned with preventing contaminated condensate from reaching boilers and prime movers, and who does not have Leeds & Northrup Company's catalog, "Micromax Condensate-Purity Instruments for the Steam Plant," will be interested in the 23 p, revised edition of this publication. It describes how condensate is sampled continuously by means of a conductivity cell, and its purity indicated by means of a Micromax recording instrument.

List Items You Want On Handy Coupon On Following Page

23 **Electronic Temperature Controller**—Bulletin No. B220 describes the new Bristol free-vane electronic controllers for automatically controlling temperature, pressure, liquid level, and humidity. Bulletin gives wiring diagrams, principle of operation and general description and features of the new instruments. The Bristol Co.

MECHANICAL TRANSMISSION

24 **Unique V-Belt Applications**—Industrial News, a 4-pg monthly bulletin issued by Gates Rubber Co., describes a number of jobs on which V-belts replaced chain and other hard-to-get materials. Includes pictures and performance data.

25 **Bearing Handbook**—Why bearings are used—the function of each type of bearing—how loads are transmitted—all the whys and wherefores of bearing designs and uses; these and every other fact needed for understanding of anti-friction bearings are set forth in a new 32-pg book entitled "Facts about Anti-Friction Bearings." Contains 75 diagrams, 41 phantom drawings and photographs, bearing descriptions in simple language. Ahlberg Bearing Co.

26 **Leather Belting**—20-pg booklet "Leather Belting Conservation and Other Engineering Data," describes the proper selection, correct installation and maintenance of leather belts, methods for aligning shafting and pulleys, cleaning and dressing oak-tanned flat leather belting, belt speeds and recommended pulley diameter tables, belting formulas and specifications. Baldwin Belting & Leather Co.

PIPING, VALVES AND FITTINGS

27 **Joint for Cast-Iron Pipe**—Many illustrations in new folder show how the Dresser Bellmaster provides a fast, flexible, tight joint for cast-iron pipe. Installed in 5 min. or less. Dresser Manufacturing Co.

28 **Steam Trap Handbook**—Tables, charts, diagrams and rules for selecting traps, giving complete explanations, make the new 36-pg Armstrong Steam Trap Book a handy reference volume for every engineer's library. Armstrong Machine Works.

29 **New Welded Piping Joint**—How the Westport welded joint provides complete penetration and smooth pipe contour without the use of backing rings is explained in new bulletin. These joints are in service on high pressure steam and water lines operating under ASME Boiler Code requirements on many installations. W. K. Mitchell & Co.

30 **Clogged Pipe Cleaner**—Suggestions for cleaning out clogged boiler tubes, pipe drains, sewers, gas lines, etc., will be found in the folder describing Miller cleanout tools. J. C. Miller Tool Sales.

31 **Steam and Oil Separators**—New 50th anniversary Bulletin No. 11-B gives construction details and installation photos of Wright-Austin steam and oil separators. Contains useful tables and charts for figuring flow of steam in pipes, pressure drop, etc., also symbols for piping and heating systems. Wright-Austin Co.

32 **Tube Expander Book**—A newly published Expander Book will be of particular interest to every engineer interested in becoming acquainted with the application and operation of tube expanders in tube rolling and expansion. The book is entitled "Airetool Expanders—Bulletin No. 21" and covers: Use and type of expanders; their care and operation; discovery and developments. Large margin on one side of each page gives engineer ample room to make marginal notes. Airetool Manufacturing Co.

WATER TREATMENT

33 **Feedwater Control**—Explained in new booklet are Rice service and supervision for testing feedwater, selecting and operating softeners, providing instructions for plant operator, etc. Also describes the Rice feed line and steam drum detectors to forecast operating difficulties. Cyrus Wm. Rice & Co.

34 **Water Softening**—"Phosphoric Acid —A new Reagent for Use With Hot Process Water Softeners" is the title of an article describing the use of phosphoric acid in single or two-stage water softeners. The article gives a comparison of chemical costs as well as data showing the effectiveness of this treatment in a typical installation. Cochrane Corp.

35 **Algae Control**—Algae control becomes of considerable interest at this time of the year in many parts of the country. The elimination of algae and slime in cooling systems is discussed in Nalco Bulletin No. 31 issued by the National Aluminate Corp.

36 **Chemicals For Water Analyses**—New 44-pg booklet, profusely illustrated, presents the various apparatus and chemicals which are used for Industrial Water Analyses for plant control. The book features the test sets required for such determinations as hardness, alkalinity, phosphate, sulfate, dissolved oxygen, ph value, silica, and others. In addition, numerous comparators, photometers, turbidimeters and so forth are displayed. Should be in the reference library of every plant chemist, power plant executive, operating engineer, or any others interested in the conditioning of industrial or municipal water. W. H. and L. D. Betz.

37 **Chemical Feeding Pumps**—New Bulletin 1100 is really a practical handbook of proportional feeding, and shows specific applications of %Proportioneers% equipment in many fields. Adjust-O-Feeder Pumps, of diaphragm and plunger types, are fully described. An unusual feature of the bulletin is a large Capacity Schedule which shows at a glance the maximum operating capacity in gallons per hr and discharge pressure in lb per sq in. ga. of all Adjust-O-Feeders. %Proportioneers, Inc.%.

MISCELLANEOUS

38 **Soot or Sifting Valve**—Construction and operation of the S-E-Co. soot or sifting valve for removing soot and siftings from hoppers is explained in new folder. Valve works easily and is dust-tight. Stock Engineering Co.

39 **Easy Floor Resurfacer**—New illustrated bulletin shows the easy steps in repairing concrete floors with Ruggedwear. This material bonds to old concrete—can be troweled to a feather edge—goes right over the old floor without any chipping. Flexrock Co.

40 **Support for Piping, Conduit**—The ease and speed with which Unistrut steel framing is used to construct piping, cable and conduit supports, motor bases, vise benches and other equipment is shown in Bulletin No. 1. Only a saw and wrench are needed. Unistrut Corp.

41 **Water Cooling Handbook**—Bulletin 806, entitled "Fundamentals of Water Cooling," provides a useful handbook for engineers and executives when planning water cooling facilities. Packed with definitions of operating terms, typical flow diagrams, performance tables and other water cooling data. The Marley Co.

42 **Heat Exchanger Balanced Wet Bulb Control**—Interesting sectional drawings in new Bulletin 96 show how temperature control of liquids or gases within 2 deg F is obtained in Niagara aero heat exchangers with balanced wet bulb control. In removing heat by air, this unit saves the cost of large installations for handling water. Niagara Blower Co.

43 **Free Repair Handbook**—A 40-pg guide to the use of Smooth-On cements contains 170 diagrams and instructions for making lasting and economical repairs to plant equipment and machinery, pipe lines, fixtures, etc. Smooth-On Mfg. Co.

44 **Gravity Feed Oilers**—Bulletin No. 26-B illustrates and describes a modernized, streamlined oiler with a crystal-clear, re-inforced plastic reservoir that is 50 per cent lighter in weight and has no gaskets to leak. The dust-proof style has an oil filter that can be removed for easy cleaning in less than five seconds without tools, mess or waste of time. Trico Fuse Mfg. Co.

45 **Belt Conveyor Handbook**—New 160-pg handbook covers design and application data on idlers, trippers and other Webster belt conveyor equipment. Typical views of installations in power houses and industrial plants are given; also latest charts and tables to assist in selecting proper conveyor units for every job. Webster Manufacturing Co.

46 **Oil Purification Data**—Bulletin "On Land and On Sea" contains interesting charts on domestic oil shortage; also pictures modern use of purification equipment with Diesel lubricating and fuel oils, turbine and electric generator oils, lubricating and cooling oils for other types of equipment. Honan-Crane Corp.

47 **Insulation**—Helpful 16-pg catalog discusses Baldwin-Hill insulations for industry and shows typical application photographs. Among the types of insulation discussed are rock-wool blanket, pipe covering, insulating cement, koldboard and weatherseal. Baldwin-Hill Co.

48 **Bolt and Nut Data**—Under the title of "Fasteners" a new publication gives latest information on bolts, nuts, screws, rivets, etc. Contains article "How tight should a bolt be?" and description of standard bolt heads and nuts. American Institute of Bolt, Nut and Rivet Mfrs.

This coupon must be filled in completely in order to secure the literature you request. Please indicate only the bulletins you particularly desire. Pasting coupon on penny postcard saves you time and money.

JUNE, 1944

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Made of vitrified clay tile. Installed with "Fiberglas" insulation. A Combination that can't be topped for permanency or efficiency.

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ADSCO-Bannon Tile Conduit is a reasonably priced easy-to-install conduit equally good for the rush job to give temporary service, just as it is ideally designed to provide a permanent installation for a post-war industrial, college or institutional project comprising one or more buildings.

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Base drain carries away ground seepage water — keeps insulation dry — prevents undue heat loss.

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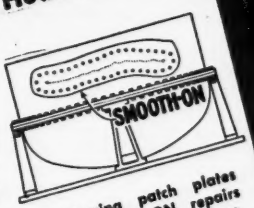
The crack was long and apparently hopeless. However, the shell was saved by tamping a putty of SMOOTH-ON No. 1 into the crack by means of a hammer. The repair was then reinforced with a patch plate which was held in place by machine screws.



Reinforcing patch plates for SMOOTH-ON repairs need not be in one piece, and frequently narrow straps or bands will serve the purpose.

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ASRE to Meet June 5-6-7

THE AMERICAN SOCIETY OF REFRIGERATING ENGINEERS for its 31st Annual Meeting, will open the morning of Monday, June 5, at the William Penn Hotel in Pittsburgh, Pa., for a three-day meeting. Sessions of the ASRE Council and meetings of various Society committees will be held on June 4, in advance of the regular sessions.

Such timely refrigeration subjects as the hydrocarbon refrigerants in low temperature fields, heat flow rates with rapid temperature changes in enclosed spaces, industrial plastics materials, and refrigeration in the synthetic ammonia industry, will be discussed by experts.

The technical sessions as announced by the ASRE Program Committee, under Clifford F. Holske, chairman, are as follows:

Monday, June 5: "Refrigerants and Absorbants", Dr. William R. Hainsworth, vice president, Servel, Inc., New York, N. Y., and past president of the ASRE; "Hydrocarbon Refrigerants in Low Temperature Fields", H. D. Edwards, The Linde Air Products Co., New York, N. Y., and past president of the ASRE; "Blast Freezer Plants", Earl D. Pollock, export manager, The Vilter Manufacturing Co., Milwaukee, Wis.; "Heat Flow Rates with Rapid Temperature Changes in Enclosed Space", H. B. Pownall and S. P. Soling, senior application engineers, York Corp., York, Pa.; "Control of a Temperature Altitude Chamber", F. W. McKenna, The Vilter Manufacturing Co., Milwaukee, Wis.; "Chromate Corrosion Inhibitors in Brine Systems", Marc Darrin, Mutual Chemical Co. of America, Baltimore, Md.; "The Use of Cold Cathode Fluorescent Lighting in Refrigerated Areas", R. C. Hultgren, production engineer, General Luminescent Corporation, Chicago, Ill.

Tuesday, June 6: "The Postwar Domestic Refrigerator", Dr. Arthur W. Ewell, Worcester Polytechnic Institute, Worcester, Mass.; "Industrial Plastics Materials: Characteristics and Factors Affecting Cost", John Sasso, managing editor, Product Engineering, New York, N. Y.; "Refrigeration in the Synthetic Ammonia Industry", J. G. Dely, consulting engineer, New York, N. Y.

Wednesday, June 7: "Psychrometry in the Frost Zone", D. D. Wile, Carrier Corp., Syracuse, N. Y.; "A Method of Determining Thermal Conductivities at Low Temperatures", Ludwig Adams, Mellon Institute, Pittsburgh, Pa.; "Refrigeration Test Equipment", Robert W. Christie, U. S. Testing Co., Inc., Hoboken, N. J.

Conover Elected Vice President of Philadelphia Electric

GEORGE R. CONOVER was elected vice president in charge of personnel and public relations of the Philadelphia Electric Co. at a meeting of the Board of Directors held April 25. The announcement was made by the president of the company, Horace P. Liversidge.

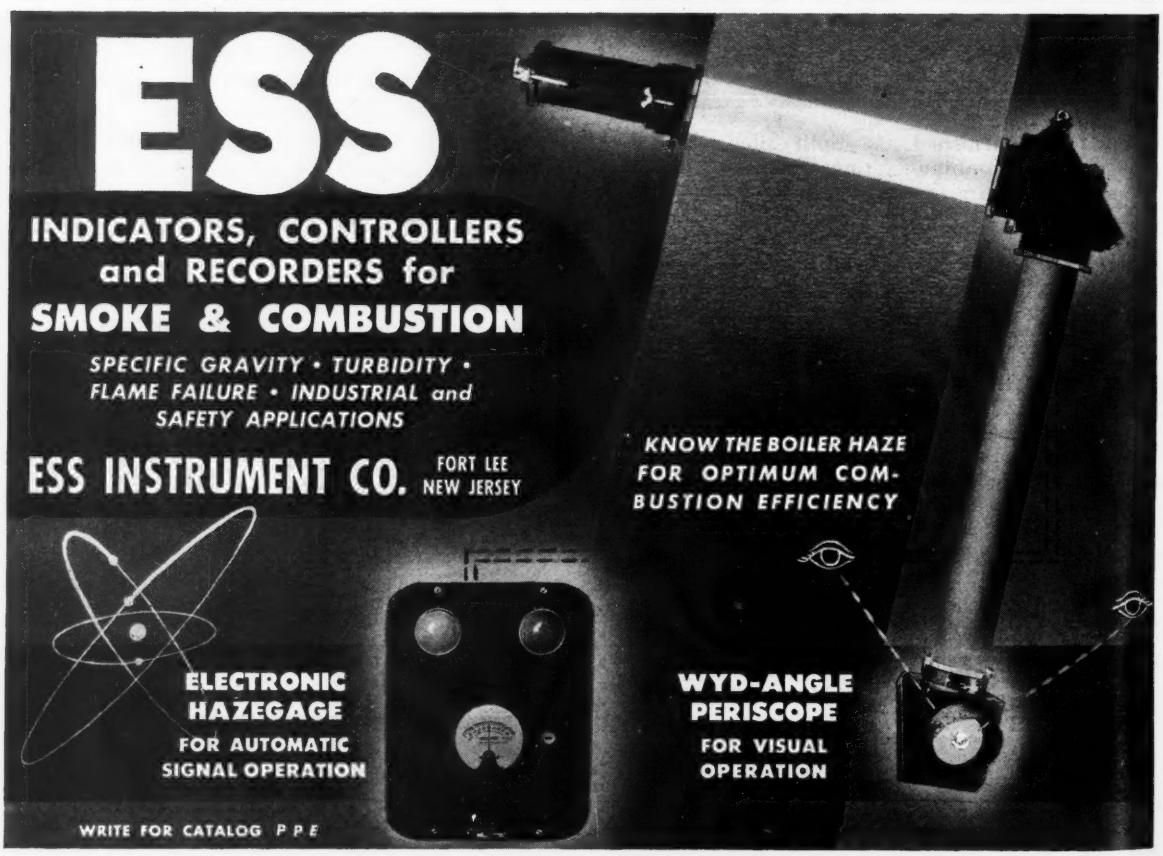
Mr. Conover, a registered electrical engineer, spent 10 yr with the Public Service Electric and Gas Co. of New Jersey before he became managing director of The Electrical Association of Philadelphia in 1929. The membership and activities of the Association rapidly increased under his leadership until it embraced a cross-section of the entire electrical industry in Bucks, Chester, Delaware, Montgomery, and Philadelphia counties. He remained with The Electrical Association until April 1, 1939, when he was made Manager of Public Relations of the Philadelphia Electric Co. On March 1, 1942, when the Electric Company's Public Relations and Personnel Departments were combined, he was appointed manager of the new department. He held that position at the time of his latest appointment.

G.E. Elects Officers

OWEN D. YOUNG and Gerard Swope were for the twenty-first time elected chairman of the board and president respectively of the General Electric Co. by the directors of the company meeting in New York April 28.

Since Mr. Young and Mr. Swope first assumed these offices in May, 1922, General Electric has grown from a company with orders of $179,000,000 a yr to one with orders, for 1943, of $1,360,000,000. Its net sales billed have increased from $221,000,000 to $1,357,000,000 during the same period. The number of stockholders has increased from 29,044 to 230,910, and the number of employees from 71,000 to 175,290.

H. V. Erben, manager of the central station divisions since 1941, has been elected a commercial vice president. Mr. Erben is a graduate of Yale's Sheffield Scientific School, as a mechanical engineer. In 1923 he was named section head of the apparatus division, later becoming manager. In 1933 he was promoted to manager of switchgear sales with headquarters in Philadelphia, where he remained until 1939, when named assistant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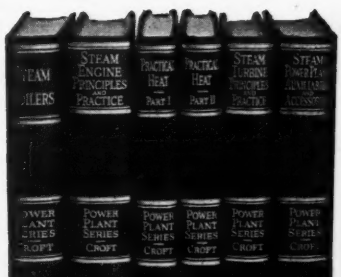

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manager of the central station divisions, a position he held until 1941, when he became manager.

Robert S. Peare, manager of publicity and broadcasting since 1940, and chairman of the company's general advertising committee, has been elected a vice president by the board of directors. In his new position, Mr. Peare will direct the company's advertising, broadcasting, and general publicity activities as a member of the president's staff.

Navy Needs Engineers

AN APPEAL is being made by the U. S. Navy for men qualified to serve as officers in connection with the servicing, maintenance and repair of internal combustion engines in operating vessels in advanced areas.

The qualifications are that applicants, having an engineering degree from an accredited college, must have at least five years of experience in the field of machinery manufacturing, installation or service. Such experience must be with steam turbines, internal combustion engines, reciprocating steam engines or electrical machinery, both a-c and d-c. In the absence of a degree, applicants must have at least 10 yr of experience, and have had responsible charge of work in the field of machinery manufacturing, installation or service of the types mentioned above. Applicants, who by virtue of their experience are thoroughly familiar with machinery actually in use in the U. S. Navy will be given preference over applicants without such experience. The age bracket is 24 to 50 yr.

Applicants must meet Naval physical requirements and possess officer-like qualities.

Applications should be made at the Office of Naval Officer Procurement, 33 Pine Street, New York 5, N. Y., or to other procurement offices located in principal cities throughout the United States.

Pit Number 5 Now Operating

THE PACIFIC GAS AND ELECTRIC CO. on April 29 put into operation its new Pit Number 5 Power House, located on the Big Bend of the Pit River in Shasta County.

Pit Number 5 has a capacity of 214,477 hp and is the largest hydroelectric plant in California. It is the 65th generating station on the P. G. and E.'s interconnected system and raises the company's electric capacity, including power available by purchase, to 2,825,155 hp. It cost more than $25,000,000 and its completion rounded out a five-year program of construction and expansion involving the expenditure of $152,000,000.

Pit Number 5 is the fifth generating plant operated by the waters of the Pit River and its tributaries. The total capacity of the five is 450,403 hp and there are four more hydroelectric power sites on the stream for future development.

Construction of Pit Number 5 began in 1941. The job was speeded to successful completion in spite of many wartime obstacles, including shortages of labor and materials and difficulties in transportation.

The site of the development is the Big Bend section of the river, where the stream makes a wide turn. The distance around the bend is approximately ten miles, but the base of the arc is only about six miles across. By diverting the river's flow across this six-mile stretch, a large volume of water is delivered to the power house under a static head, or fall, of 630 ft—the difference in elevation between the point of diversion and the power house.

The diversion dam is of concrete, 350 ft long and 110 ft high from the stream bed to the top. Four steel gates, each weighing 90 tons, control the flow of water.

To carry the water to the power house there are 3185 ft of open conduit and 5.33 miles of concrete-lined tunnel, all with a capacity of 3300 cfs. About half of the tunnel is circular, 19 ft in diam, and the rest is horseshoe-shaped, 19 ft wide by 19 ft high.

From the tunnel to the plant are four steel pipelines, or penstocks, each 1380 ft long, 9 ft in diam at the top and 7½ ft in diam at the bottom.

The power house is a steel and concrete structure, with a main building 266 ft long by 56 ft wide and a switch house 182 ft long by 34 ft wide. It has four generators, each with a capacity of more than 53,600 hp.

Two 220,000-v circuits, each 14 miles long, connect the plant with the transmission system that carries Pit River power to the Vaca-Dixon substation in Solano County.

Verd-A-Ray Corp. Formed

VERD-A-RAY CORP. has been issued papers of incorporation by the State of Ohio and will manufacture and deal in electronic devices. Verd-A-Ray, a relatively new type of color correcting incandescent lamp, was originated by Save

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Airetool's New Form Cutters remove deposits without damage to tubes, with the usual tendency to dangerous tracking eliminated. Drill, brush and knocker heads are also available. The Airetool motor, air or steam driven, develops 28% increased power, starts under heavy load, and loads down to 50 rpm without stalling. It has slip-fit construction which permits quick take-down and reassembly on the job without special tools. Write for bulletin.

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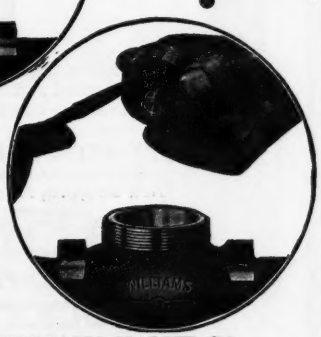

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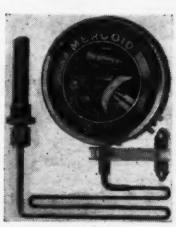

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Electric Corp. of Toledo, Ohio and was acquired by the new corporation May 1.

Max Ettinger is the president of the new corporation, E. G. Kirby, Toledo banker, is treasurer, and Jack Siegel, a New York accountant, is secretary. W. Ira Merell is assistant treasurer and comptroller, H. J. Howard, Miami corporation attorney will serve actively as assistant secretary and assistant to the general manager. O. J. Schroeder, formerly in charge of Westinghouse lamp manufacturing at Bloomfield, N. J., is vice president in charge of manufacturing and M. J. Grosse, formerly sales manager for Save Electric Corp., is vice president in charge of sales.

Among administrative officials is W. Perry White, director of merchandising; Ewald Liebau, manufacturing superintendent; Ormonde Levi, inventor of Verd-A-Ray, director of research; and Dr. Robert Beer, director of engineering. Promotion and advertising will be supervised by Gere Burns.

Allen Awarded Medal

FRANK B. ALLEN, President of The Allen-Sherman-Hoff Co., Philadelphia, was awarded the Edward Longstreth Medal of The Franklin Institute on April 19. This honor was bestowed on Mr. Allen for his invention of a "Seal Ring" for use in centrifugal pumps (Hydroseal Pumps) handling abrasive solutions. The actual citation from The Franklin Institute reads as follows: "In consideration of the development of a pump (Hydroseal) which will successfully handle water or liquids containing abrasive materials, retain its initial efficiency and original discharge for considerable periods, with low maintenance costs and the successful manufacture of this type of pump (Hydroseal), giving satisfactory operation in many installations.

"Allen's Hydroseal Pump, the special features of which have been patented by him, is provided with a supply of clean flushing water between rotating impeller and stationary side plates to prevent entry of abrasive materials into these spaces, thereby greatly reducing wear at the pump seals. By this means, the initial high efficiency and initial discharge are maintained for a far greater period than in former types of pumps for handling abrasive solutions."

Westinghouse Elects Vice Presidents

FOUR NEW VICE PRESIDENTS of the Westinghouse Electric and Manufacturing Co. have recently been chosen. The new officers and their former positions are R. A. Neal, manager of the Switchgear Division at the East Pittsburgh Westinghouse Works; J. K. B. Hare, manager of the Company's Central District sales activities with headquarters in Pittsburgh; John H. Ashbaugh, manager of the Westinghouse Electric Appliance Division, with headquarters in Mansfield, Ohio; and H. H. Rogge, manager of the Company's Washington Government Office.

Mr. Neal, who came to Westinghouse as an electrical engineer in 1910, the year he received his Bachelor of Science degree from the University of New Hampshire becomes Vice President and Sales Manager, reporting to B. W. Clark, who is Vice President in charge of all sales activities of the Company.

Mr. Rogge for the time being will continue to make his headquarters in Washington. The responsibilities of Mr. Hare and Mr. Ashbaugh are unchanged.

Dr. Rose Joins BCR

BITUMINOUS COAL RESEARCH, INC., has announced the election of Dr. H. J. Rose, of Mellon Institute, Pittsburgh, as Vice President and Director of Research in charge of the expanded investigational and developmental program of the bituminous coal industry. This organization of coal operators, associations, and railroads in the Appalachian and Mid-Continent coal fields is enlarging its research projects on coal production and utilization to meet wartime problems and to prepare for and strengthen the industry's post-war position. More than two million dollars will be invested in this research program during the next five years.

Dr. Rose has had extensive experience in the technical and administrative phases of coal research. Starting with The Koppers Company in 1918, he became assistant director of research of that organization. He has been with the anthracite industry since 1932, and is resigning as vice president in charge of research of Anthracite Industries, Inc., New York, N. Y., to accept the new position. In assuming direction of the broader domain of bituminous coal research, he is returning to his original field of activity. He has been associated with Mellon Institute throughout his professional career.

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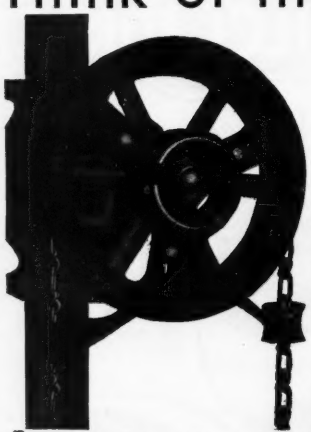

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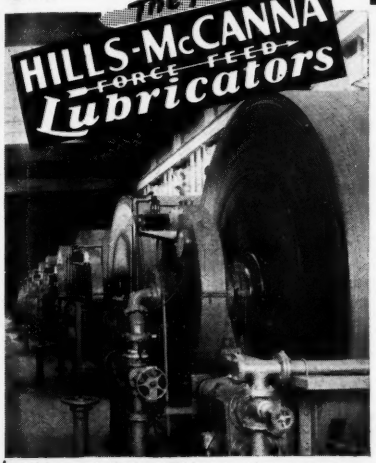

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Hills-McCanna's keep your lubrication schedules up to the minute . . . they never forget or overlook a bearing. Feed lines controlled by individual non-failing pump valves, supply the exact quantity of oil to each friction point . . . on time . . . all the time.

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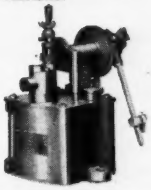
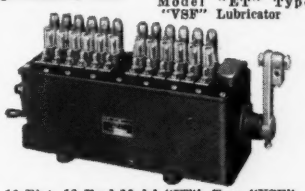
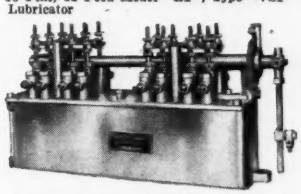


2 Pint, Single Feed Model "ET" Type "VSF" Lubricator



16 Pint, 12 Feed Model "ET", Type "VSF" Lubricator



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SPA Program for Detroit Meeting

AT THE ANNUAL MEETING of the Smoke Prevention Association of America to be held at Hotel Statler in Detroit, Mich., June 6 to 9, inclusive, the major part of the program will be devoted to the part which city officials must take in the problems of eliminating air pollution but a considerable portion of the program will deal with fundamental causes of smoke and how it can be prevented by the proper handling of furnaces. Also prominent on the program are papers dealing with fuel conservation, the importance of which is too evident during these war times. The program follows:

Tuesday noon, June 7. Fuel Conservation Program, R. R. Sayers, Director U. S. Bureau of Mines; Smoke Abatement and City Planning, George F. Emery; Conservation After Combustion, R. E. Thomas; Influence on Post War Smoke Abatement Work of the Bituminous Coal Research Program, Julian E. Tobey; Service Training of the Operating Personnel, As It Effects Fuel Conservation and Smoke Abatement, Hugh B. Dolan; City Incineration, Robert H. Stellwagon.

June 7. New Developments of Front Overfeed Stokers, Thatcher W. Rea; Smoke Abatement from The Stoker Manufacturers' Viewpoint, J. W. Armour; Fly Ash Collection at the Boiler, J. A. Hoffman; Studies of Stoker Fuel Beds, Otto de Lorenzi; Some of the Economies Effected by Fly Ash Collection, Leonard F. Lang; Studies of Boiler Fly Ash Collection, A. P. Darlington; Innovations in Incineration and Fly Ash Collection, Ellis E. Smander; Methods of Control of Stack Emission from Powdered Fuel Fired Equipment, Valory S. Baretta.

June 8. Round Table Discussion on Railroad Locomotive Smoke Abatement and Fuel Problems Moderator, Eugene D. Benton. Speakers: J. C. Shove, Leland G. Plant, H. J. Riddle, John E. Bjorkholm and P. T. Tolin. Joint Fuel Conservation Meeting at Rackham Memorial Building, subject, Fuel Efficiency Program, speaker, Thomas C. Cheasley.

June 9. Weather and Air Pollution, Clarence J. Root; Power Practices in Detroit Water Works, A. C. Michael; A Resume of the History of Atmospheric Solids Collections in the City of Detroit, Frank J. Gibbons.

Santee-Congaree River Project Estimated At $134,000,000

THE PROPOSED Santee-Congaree River development in South and North Carolina, projected by the South Carolina Public Service Authority, Charleston, S. C., has been approved by U. S. Army Engineers Office, Bureau of the Budget, and Federal Power Commission, Washington, D. C., and has been placed before the Senate Commerce Committee for final action. Entire project is estimated to cost about $134,000,000, and will be carried out as a postwar development. Program provides for construction of a series of eight power dams to be located at or near the following places: Clinchfield, Gaffney, Cherokee Falls, Lockhart, Blairs, Frost Shoals, Columbia and Buckingham Landing. Hydroelectric power plants to be constructed at these points are estimated to have a gross capacity of 285,000-kw, with work to include reservoirs, pipe lines and other operating facilities. Also, transmission system for interconnection between the different stations, power substations and switching stations and other field structures. Federal Power Commission has recommended that initial construction be carried out at Blairs, near Parr Shoals; Columbia; Clinchfield in North Carolina; and Frost Shoals, above Columbia, in order named. These developments are estimated to cost about $49,661,000; of this total, the Blairs project will cost approximately $21,176,000, and that at Frost Shoals, $16,641,000, exclusive of transmission lines and field facilities. Program also provides for expansion and improvements in existing hydroelectric generating stations at Pinopolis and on the Broad River, with installation of equipment for increased capacity. The development will provide for flood control throughout the area.

Ohio Plants Being Improved

WILLIAM C. KAMMERER AND ASSOCIATE, Consulting Engineers, 1900 Euclid Ave., Cleveland 15, Ohio, report that they are carrying out plans to remodel the county power plant of Miami County, Ohio. Plans also are under way for the construction of a coal handling system for the municipal light and power plant at Wellington, Ohio.

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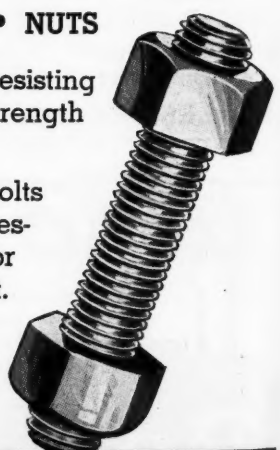

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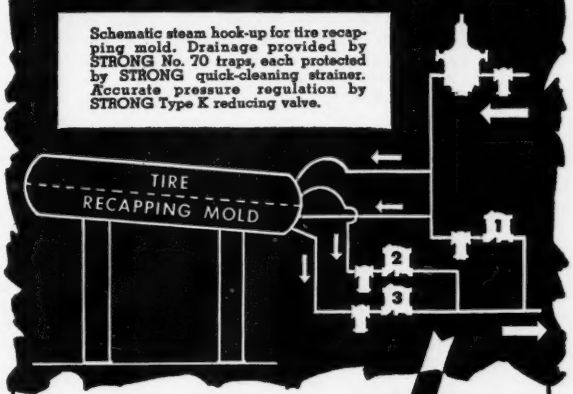

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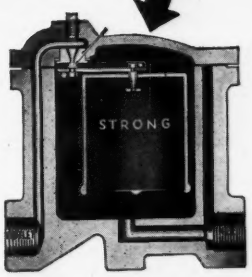

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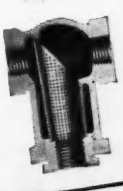

Open Bucket Traps

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Power Plant Construction News

Calif., Los Angeles — Bureau of Yards and Docks, Navy Dept., Constitution Ave. and 18th St., N.W., Washington, D.C., plans expansion in power supply facilities at naval operating base, Terminal Island, San Pedro district, including power substation extensions, distribution lines, service connections and other work. Cost estimated at $300,000. Appropriation has been arranged. Public Works Office at base will be in charge.

Calif., South San Francisco—Matson Navigation Co., 215 Market St., San Francisco, plans new aircraft repair and maintenance plant at Mills Field, San Mateo County, to be used as a main base in connection with proposed postwar transpacific airline to be operated by company. It will comprise hangars, shops and other structures. Electric power equipment will be installed. A power substation is planned and other electrical operating facilities. Entire project will cost about $1,500,000. Application for permission has been made to Navy Dept., Washington, D. C.

Conn., Bridgeport—Berkshire Chemical Co., 92 Howard Ave., plans installation of electric power equipment in connection with rebuilding of portion of solvent extraction plant of castor oil division, recently destroyed by fire, with loss reported over $150,000. It is understood that project has a priority rating.

Ga., Eastman—Dodge County Freezer & Locker Co., Eastman, has plans maturing for new refrigerated locker plant on local site, to be one-story, estimated to cost close to $40,000, with equipment. It is understood that project will have a priority rating. J. B. McCrary & Co., 22 Marietta St. Bldg., Atlanta, Ga., are consulting engineers.

Idaho, Boise—Bradley Mining Co., James P. Bradley, vice-president, plans installation of electric power equipment in proposed new tungsten concentrating plant on South Eighth St., where former building of Boise Gas Light & Coke Co., has been secured. Structure will be remodeled and equipped at once. Cost reported close to $90,000, with machinery.

Ind., Terre Haute — War Dept., Pentagon Bldg., Arlington, Va., has authorized conversion of Vigo ordnance plant near Terre Haute for new works for production of smoke bombs, including additional buildings, modification and changes in existing structures, and other improvements, with installation of additional electric power equipment, distribution lines and other electrical facilities. Entire project will cost about $5,382,000, and will be carried out under the direction of U. S. District Engineers Office, Federal Bldg., Louisville, Ky.

Iowa, Waterloo—Rath Packing Co., Waterloo, meat packer, has plans under way for addition to power plant, including installation of additional equipment for increased capacity. No estimate of cost announced. Bids are scheduled to be asked soon. Project will have a priority rating. Henschien, Everds & Crombie, 59 East Van Buren St., Chicago, Ill., are consulting engineers.

Ky., Louisville—E. I. duPont de Nemours & Co., Rubber Chemicals Division, duPont Building, Wilmington, Del., plans installation of electric power equipment in new addition to branch Neoprene synthetic rubber mill on Camp Ground Road, Louisville, reported to cost over $200,000. Work will begin at early date.

Md., Indian Head — Bureau of Yards and Docks, Navy Dept., Constitution Ave. and 18th St., N. W., Washington, D. C., plans installation of additional boilers and auxiliary equipment in power house at naval powder factory, Indian Head, for steam supply for processing service. Cost estimated about $200,000. Appropriation has been authorized.

Mass., Boston—Boston Edison Co., 39 Boylston St., will begin work soon on addition to local steam-electric generating station, with installation of additional equipment for increased capacity. No official estimate of cost as yet announced. Award for structural steel framing has been made to American Bridge Co., Pittsburgh., Pa. Project will have a priority rating.

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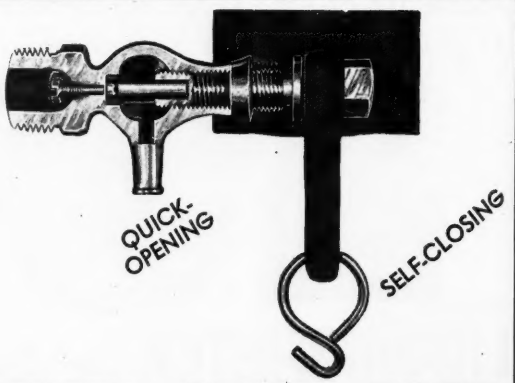

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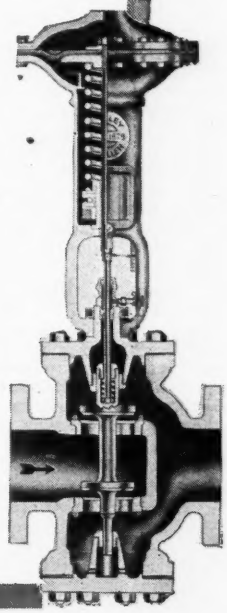

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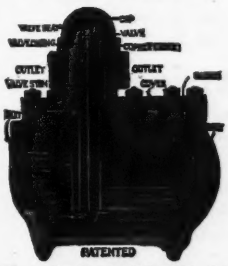

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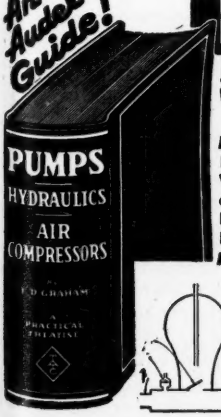

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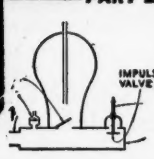

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Mich., Detroit—Chrysler Corp., 341 Massachusetts Ave., will make extensions in several local plants for increased production of tanks, anti-aircraft cannon, and other equipment for Government, including plant on East Jefferson St., Plymouth Division Works at 6334 Lynch Rd., Dodge Division plant at 7900 Joseph Campau Ave., and works at Highland Park. Electric power equipment will be installed. Cost estimated about $3,071,000, with financing provided by Defense Plant Corp., Washington, D. C. Work is scheduled to begin soon.

Minn., Jackson — Electric Light Dept., plans post war expansion program at municipal power plant, including installation of new turbine-generator unit, boiler, switchgear and auxiliary equipment. Cost estimated close to $200,000. Jesse B. Harris Co., Essex Bldg., Minneapolis, Minn., is consulting engineer.

Minn., St. Paul — Great Northern Railway Co., Great Northern Railway Bldg., 175 East Fourth St., has plans for new boiler house, about 51 x 56 ft, at local Jackson St. yards. Cost reported about $50,000, with equipment. Project has a priority rating and will be placed under way at once. Thomas D. McMahon, address noted, is company architect.

Mo., Licking—Intercounty Electric Cooperative Association, Licking, plans extensions in rural electric system in parts of Phelps County, including primary and secondary lines, line transformers, service connections and other operating facilities. Cost about $145,000. Financing has been arranged through Federal aid and work is scheduled to be carried out soon.

New Mexico—El Paso Natural Gas Co., El Paso, Tex., plans expansion in natural gas plant in Lea County, including extensions in residue gas treatment station and gas compressor plant, with installation of equipment for large increased capacity. Also additional pipe lines, controls and other facilities. Cost estimated about $886,000. A priority rating has been secured and program is scheduled to be carried out at once.

N. M., Monument—Warren Petroleum Corp., National Bank of Tulsa Bldg., Tulsa, Okla., plans expansion in gasoline plant at Monument, including installation of boiler units and accessories, heat exchangers, pumping machinery, air compressors, tanks and other equipment. Cost estimated about $425,000. Project has a priority and work will begin soon. W. K. Warren is president.

Ohio, Chillicothe — Construction Service, Veterans' Administration, Washington, D. C., will receive bids until June 20 for addition to boiler plant at institution at Chillicothe, as per plans and specifications on file.

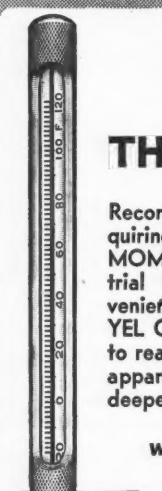
Ohio, Zanesville—City Council has authorized surveys and estimates of cost for new water-softening plant for municipal waterworks. Finkbeiner, Pettis & Stout, Nicholas Bldg., Toledo, Ohio, are consulting engineers.

Texas, Fort Worth—Consolidated-Vultee Aircraft Corp., Grants Lane, plans installation of electric power equipment in connection with expansion in local plant for production for Government, including several additional buildings, with machinery and facilities for increased capacity. Entire project is estimated to cost about $2,475,000, with financing provided by Defense Plant Corp., Washington, D. C. Work is scheduled to be carried out soon.

Wis., Kenosha — Nash-Kelvinator Corp., plans one-story addition, about 350 x 550 ft, at local automobile plant, now given over to producton of war materials for government, reported to cost over $1,000,000, with machinery. Electric power equipment will be installed. This is part of a large expansion program to be carried out at plant for increased production, entire project estimated to cost about $9,500,000. Financing will be provided by Defense Plant Corp., Washington, D. C. Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich., is architect and engineer.

Wis., La Crosse—Swift & Co., 2126 South Ave., meat packers, have plans for addition to boiler house at local plant, reported to cost over $40,000, with equipment. Erection is scheduled to begin soon. Project will have a priority rating. Main offices are at Union Stock Yards, Chicago, Ill.

Wis., Richland Center—Municipal Light Utility, 170 North Central Ave., is considering installation of new electric generator, boiler and auxiliary equipment in municipal power station. Surveys and estimates of cost have been made by Ralph D. Thomas & Associates, 1200 Second Ave., South, Minneapolis, Minn., consulting engineers. It has not been announced whether project will be carried out at present time under priority rating or held as a postwar development.



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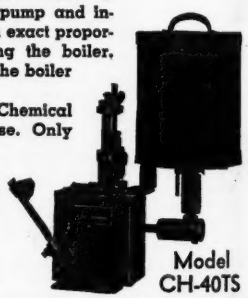

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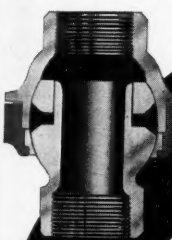

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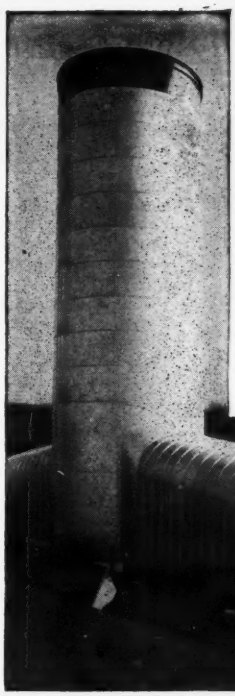

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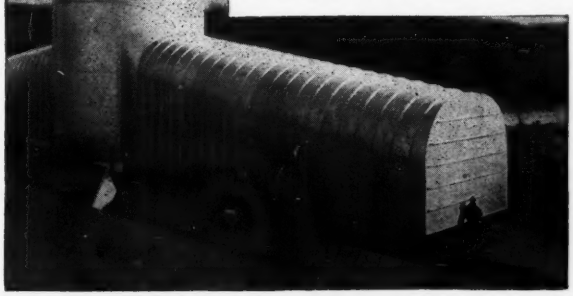

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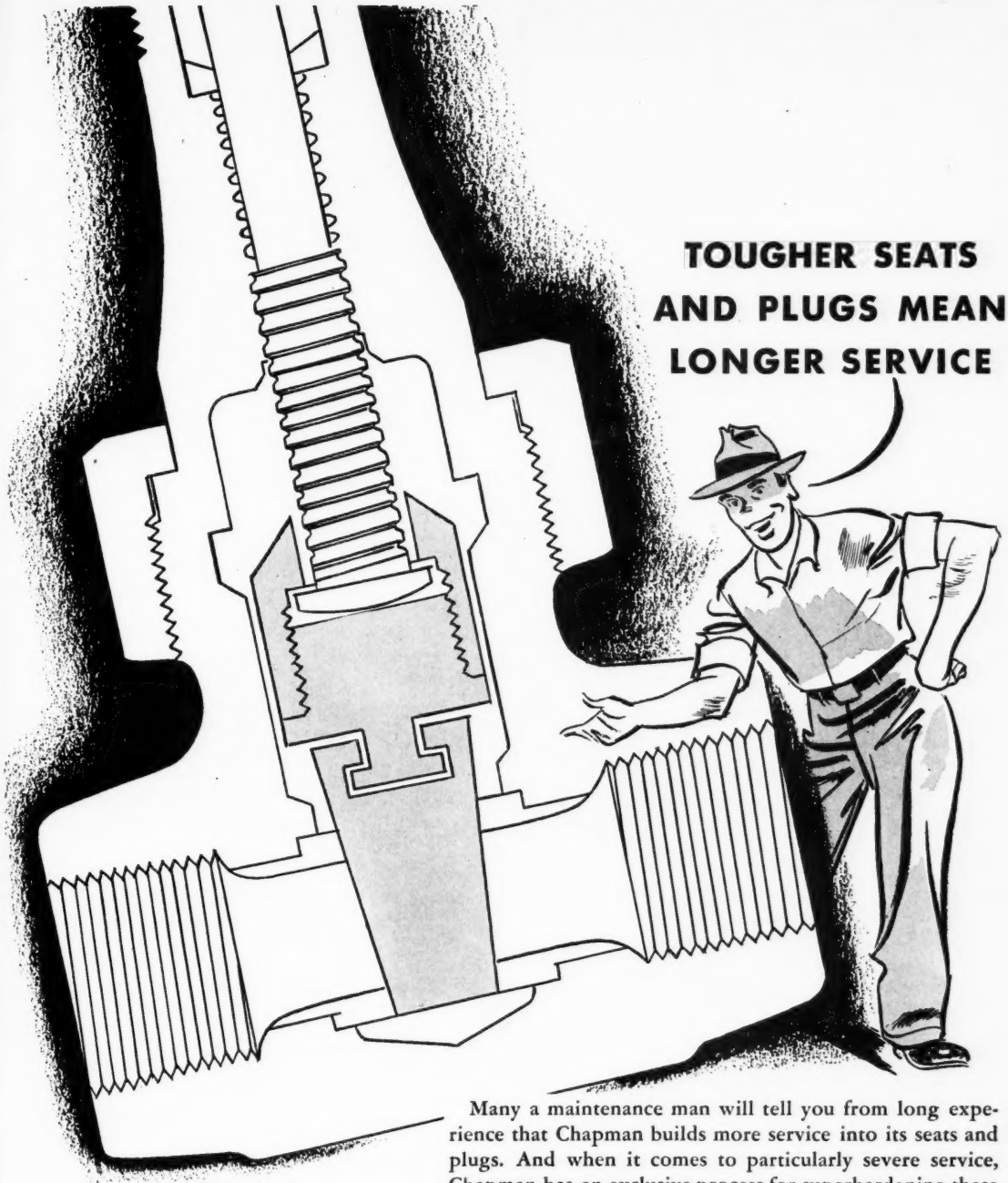

TOUGHER SEATS AND PLUGS MEAN LONGER SERVICE

Many a maintenance man will tell you from long experience that Chapman builds more service into its seats and plugs. And when it comes to particularly severe service, Chapman has an exclusive process for superhardening these parts that give them even longer life.

When these parts finally do wear out, you'll find Chapman standing by ready to see that you get replacements *quickly*.

Other Chapman extra-service features are quick-acting threads that open and close without sticking or freezing... and full pressure repacking—made possible because the pressure is not transmitted to the stem.

That's why so many experienced power men stand by Chapman List 960.

Specify

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FOR LONGER LIFE

THE CHAPMAN VALVE MFG. COMPANY

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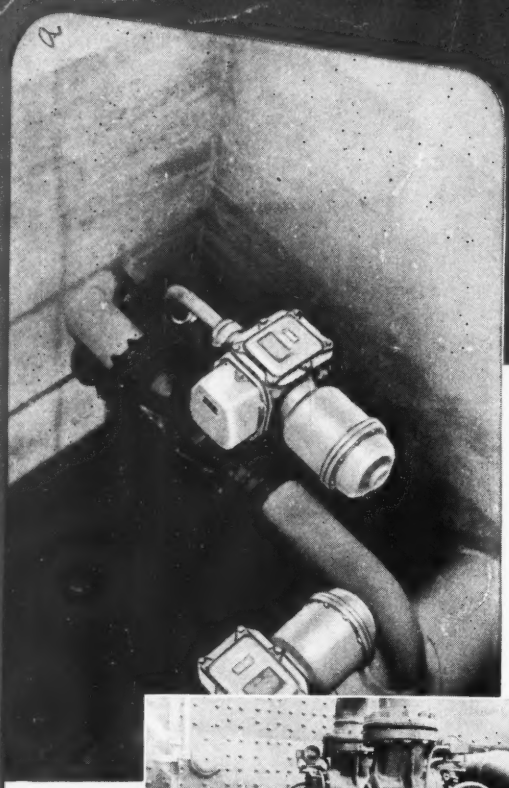
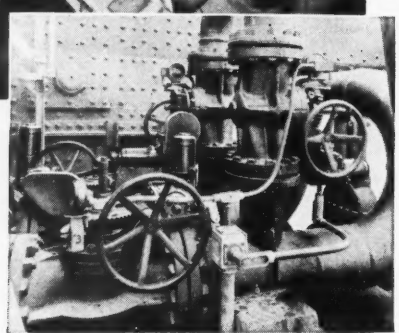
CUTLER-HAMMER
MOTORIZED VALVE OPERATORS





for better process control and plant operation . . .

Do you have valves too large, too hot, too "sticky," too hard to reach for efficient operation by hand? Do you need a simple, better or entirely automatic means of controlling valves in complex refining or chemical processes? Do you want instant operation of valves that are yards—or miles—apart? Do you want to conserve time and manpower in your plant? Or are you looking for valve control that not only *starts* any valve but will seat it safely with *positive protection to seat, gate, stem and mechanism?*

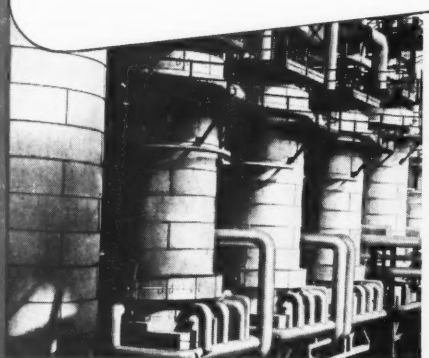
You will find what you want in the Cutler-Hammer Line of Motorized Valve Operators. You will find further, that in choosing Cutler-Hammer Valve Operators for the vast majority of installations, their purchasers are simply recognizing the overwhelming importance of dependability and superior engineering . . . the qualities that have always distinguished Cutler-Hammer design. CUTLER-HAMMER, Inc., 1210 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ont.

TO CUT BATCHES SHARPLY AND REDUCE CONTAMINATION IN PIPELINE OPERATION

212 Cutler-Hammer Valve Operators on the "Little Inch" pipeline from Texas to New Jersey, uncounted hundreds on other lines, indicate the importance of rapid, fully automatic and centralized control of valves in modern pipeline practice. It gives protection to product quality obtainable by no other means.

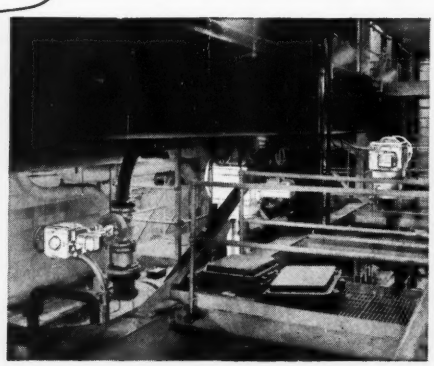
CUTLER-HAMMER
VALVE CONTROL
C-H

ARMY E NAVY
Milwaukee Plants



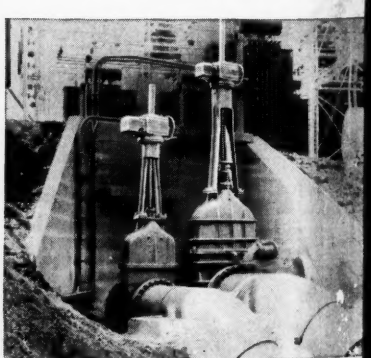
FOR SIMPLE, PRECISE CONTROL IN COMPLEX PROCESS INDUSTRIES

The widespread use of Cutler-Hammer Valve Control in high octane refining processes and other chemical process industries demonstrates the gains that result from fully automatic, often inter-locked sequence control of valves.



WHERE MEN CAN'T GO WHAT MEN CAN'T DO

High pressure, high temperature steam lines and valves often glow red . . . too hot to handle . . . too hard to turn. C-H controlled-thrust-seating operators operate these valves at the touch of a conveniently located push button . . . without danger of jamming.



TO OPERATE A VALVE IN THE NEXT COUNTY *NOW*

Distance means nothing to Cutler-Hammer Valve Control. The operation of any valve or any number of valves in the next room, on the next floor, or miles away is immediate, certain, easy . . . a matter of pushing a button located wherever convenience dictates.

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